NEW YORK SEATTLE

MOTORSHIP

Devoted to Marine Oil Engine and Motor Vessels

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EXCLUSIVE technical and non-technical articles on design, construction and operation of oil-engines and motorships by the world's foremost writers on marine engineering.

MOTORSHIP

(Trade Mark Registered)

PROFUSELY illustrated with photograph c reproductions of the newest designs in international merchant motorship and Diesel-engine construction and auxiliary equipment.

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(Cable Address—Freemote, New York)

Missourian's Performance Compares with Californian's

The United American Line's 16,500 Tons Displacement Diesel-Driven Freighter Completes Successful Maiden-Voyage of 20,416 Nautical Miles

STEADY sequence of reliable operations in long-distance voyages by big American motorships in charge of American engineers is rapidly upsetting the theory of the greatest difficulty facing domestic ship-owners being that no engineers are available. Operations on voyages of 20,000 miles and over of the motorships WILLIAM PENN, CALIFORNIAN, MISSOURIAN, KENNICOTT, H. T. HARPER, etc., have shown conclusively that there is no necessity for engineers to be actually experienced with oil-engines provided they are men of intelligence, having an aptitude to learn, and have been given several months' tuition either in the engine-builders' shops or in the engine-room of a motorship. Under the supervision of a guarantee-engineer such men can take charge of a Diesel plant. It is shown that some engineers accustomed to marine steam-engines or large gasoline engines have a natural aptitude for successful operation of oil-engines, and a few weeks at sea under the supervision of an experienced engineer have rapidly turned these men into Diesel-operating experts.

Recently the United American Line's motorship MISSOURIAN arrived at her home port following the successful conclusion of her maiden voyage of 20,416 nautical miles. She covered practically the same route as her sister-motorship CALIFORNIAN, whose voyage was described on pages 833-835 of our November, 1922, issue. At the time, extracts from the log were given, so it will be very interesting to compare the two voyages. The MISSOURIAN was 71.4 days at sea and 66.6 days in port, a total of 138 days. She averaged a speed for the 20,416 miles of 11.96 knots on a total fuel-consumption of 7,461 bbls. or 1,066 tons. It is only necessary for any steamship owner to compare this consumption with that of a steamship of the similar *net* cargo-capacity (exclusive of fuel and storage) at the same speed. In arriving at the fuel-consumption given in the accompanying extract of the log of the MISSOURIAN the total amount of oil consumed, including that for the galley and donkey-boiler, is divided by the I.H.P. of the main engines. This method results in higher consumption per I.H.P. than in the case of the WILLIAM PENN, where the total fuel-consumption, exclusive of donkey-boiler, was divided by the I.H.P. of the main-engines only, in accordance with Cramp's practice.

At the start of the voyage the MISSOURIAN had 9,102 bbls. of fuel-oil aboard and at Port Costa, San Francisco, she took aboard 2,143 bbls., making a total of 11,245 bbls. At the end of the 20,416 miles voyage she had in her double-bottoms a total of 3,784 bbls. At sea her average consumption for all purposes was 105 bbls. or 15 tons per day, while in port her consumption was 7.07 bbls.

In order that ship-owners may compare the MISSOURIAN with their own steamers we give herewith her leading dimensions, etc.:

CAPACITY

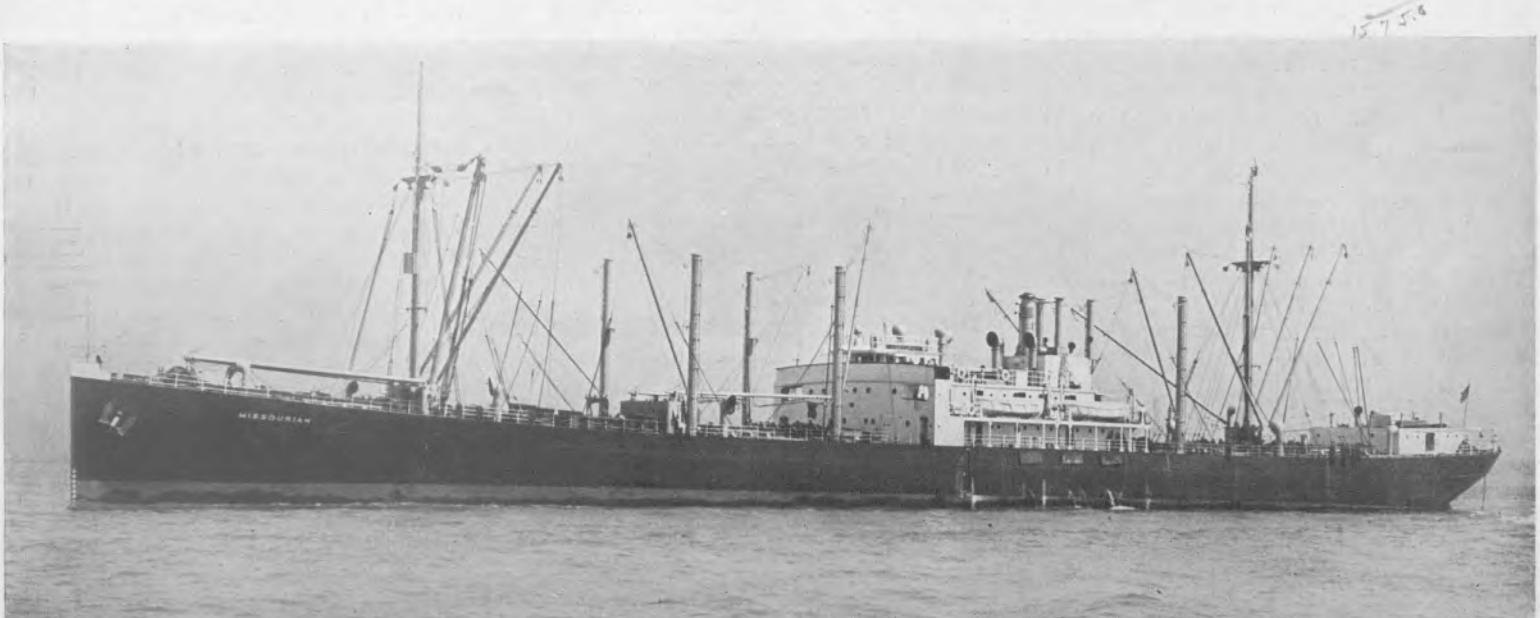
Loaded displacement at 28' 6" dft.	16,500 tons
Light displacement	5,300 tons
Net cargo-capacity on long distance voyage not including fuel, etc.)	9,585 tons
Underdeck cargo-capacity (grain)	598,492 cu. ft
Capacity of deep tanks and hatches	50,610 cu. ft.
Refrigerated space	1,277 cu. ft.
Total cubic cargo-capacity	650,379 cu. ft.
Fuel-capacity (in double bottoms, settling tank, and supply tanks)	1,368 tons
Fresh-water capacity	208 tons

DIMENSIONS

Length O. A.	461' 7½"
Length B. P.	445' 0 "
Breadth M. D.	59' 8 "
Depth (Moulded to S. D.)	39' 0 "
Draught, loaded	28' 6 "
Block Coefficient	0.76
Midsection Coefficient	0.986

POWER

Twin six-cylinder 29⅛"x45" at 115 R. P. M. .....2,250 I.H.P. each



The "All-American" motorship "Missourian," sister vessel to the "Californian," also operated by the United American Lines

Four auxiliary Diesel-electric-
sets of 65 K.W. . . . . 75 to 100 b.h.p. each

SPEEDS AND CONSUMPTIONS

Average maiden voyage speed . 11.96 knots
Fuel-consumption per 24 hours
(all purposes at sea) . . . . 15 tons
Consumption in port . . . . 1 ton

WEIGHTS

Weight of two main engines
together . . . . 545 tons
Complete weight of machinery, including generators auxiliary Diesels, tanks, etc. . . . . 930 tons
Weight of hull and machinery . . 5,300 tons
Length of machinery space (incl. thrust recess) . . . . 60′ 8″

The report issued by the owners of the MISSOURIAN states that her performance throughout the trip was most satisfactory. No engine repairs were required throughout the voyage and her machinery ran without a hitch. The average speed on the last leg of the voyage, from Hamburg to the United States, with a displacement of nearly 12,000 tons was slightly over 12 knots Furthermore, the owners report that the MISSOURIAN, when she arrived was ready to sail again for the West Coast without any repairs whatsoever to her propelling machinery, which is most unusual for a new ship after a voyage of this length. Referring to the low speed on the Seattle-Tacoma and Tacoma-Seattle stages, these were run on one engine because of the short distance, and there was a fog at the time.

It is worth while drawing attention to the fact that the builders were able to arrange the engineer's quarters to open directly on the deck and into the engine-room because of the absence of heat which prevails in the engine-rooms of steamships. Officers and engineers are most enthusiastic over the ship and her performance and her owners are highly pleased.

We take the opportunity to again say that the MISSOURIAN was built by the Merchant Shipbuilding Co. at Chester, Pa., while her Burmeister-Wain type Diesel-engines were constructed and installed by the Wm. Cramp & Sons Ship & Engine Building Co., at Philadelphia, Pa.

Below is reproduced extract of the MISSOURIAN's log, furnished by Supt'g. Engineer Mills of the United-American Line:

Left—	Arrived—	Time Hours	Observ. Distance Knots	Average Speed	Average R.P.M.	Average I.H.P.	Fuel Bbls.	Oil Consumption Gals.	Oil Consumption Lbs.	Lbs./Hr.	Lbs. I.H.P. Hr.	Knots/Bbl.	Slip.	Draft Leaving	Draft Arriving	Donkey Boiler
Philadelphia....July 10	New York......July 11	18.18	222	12.20	121.5	.....	87	3,654	27,448	1,511	.....	2.55	13.2	12′ 11½″	12′ 9½″	.....
New York......July 12	Boston.........July 13	27.27	352	12.92	117.3	.....	115	4,830	36,282	1,330	....	3.06	5.1	12′ 7½″	12′ 5″	.....
Boston.........July 15	Philadelphia....July 17	33.45	432	12.93	118.0	.....	148	6,216	46,694	1,395	....	2.92	5.5	13′ 9½″	13′ 11″	.....
Philadelphia....July 20	New York......July 21	10.47	130	12.40	113.0	.....	39	1,632	12,290	1,172	....	1.91	5.4	18′ 7½″	18′ 3½″	.....
New York......July 24	Cristobal.......July 30	158.70	1,948	12.27	112.2	4,365	672	28,238	212,121	1,339	.306	2.90	5.9	23′ 1½″	22′ 9½″	.....
Balboa.........July 31	San Pedro......Aug. 10	233.25	2,917	12.50	113.9	4,397	1,022	43,008	323,072	1,389	.316	2.85	5.0	22′ 9½″	22′ 8½″	.....
San Pedro......Aug. 13	San Francisco...Aug. 14	31.82	355	11.16	107.95	4,200	136	5,720	42,968	1,349	.320	2.61	10.9	18′ 10½″	18′ 9½″	.....
San Francisco...Aug. 17	Seattle.........Aug. 19	67.80	801	11.81	110.2	4,150	261	11,005	82,667	1,220	.294	3.07	7.7	13′ 10″	13′ 9″	.....
Seattle.........Aug. 22	Tacoma........Aug. 22	3.85	25	6.5	94.8	.....	8	320	2,404	624	....	3.125	40.6	12′ 9″	12′ 9″	.....
Tacoma........Aug. 24	Seattle.........Aug. 24	3.00	24	8.0	92.0	.....	8	320	2,404	804	....	3.0	25.0	14′ 0″	14″ 0″	.....
Seattle.........Aug. 27	Portland.......Aug. 28	21.73	268	12.35	111.7	.....	85	3,600	27,043	1,248	....	3.15	4.6	14′ 4″	14′ 6″	.....
Portland.......Aug. 31	San Francisco...Sept. 2	43.02	537	12.50	110.4	4,200	173	7,290	54,762	1,271	.304	3.10	2.2	16′ 10½″	16′ 4½″	.....
San Francisco...Sept. 9	San Pedro......Sept. 11	33.25	355	10.67	101.0	.....	121	5,100	38,311	1,151	....	2.94	9.0	25′ 6″	25′ 5″	.....
San Pedro......Sept. 12	Balboa.........Sept. 22	247.18	2,916	11.80	112.2	4,341	1,091	46,020	345,698	1,399	.3225	2.67	9.4	26′ 6″	26′ 3″	.....
Cristobal.......Sept. 23	Liverpool.......Oct. 10	397.25	4,536	11.42	110.1	4,300	1,740	73,018	548,504	1,380	.321	2.60	10.5	26′ 3″	25′ 10″	.....
Liverpool.......Oct. 19	Glasgow........Oct. 20	15.92	187	11.71	109.5	4,550	70	2,940	22,079	1,386	.305	2.67	7.8	....	....	Used
Glasgow........Oct. 26	Dunkirk........Oct. 28	59.7	676	11.34	110.6	.....	266	11,130	83,607	1,401	....	2.54	11.5	....	....	Used
Dunkirk........Nov. 1	London........Nov. 1	7.61	86	11.29	110.8	.....	29	1,220	9,160	1,201	....	2.96	12.2	....	....	Used
London........Nov. 7	Hamburg.......Nov. 8	23.45	285	11.65	112.7	.....	102	4,270	32,076	1,368	....	2.80	10.7	....	....	Used
Hamburg.......Nov. 11	Boston.. ......Nov. 22	270.33	3,364	12.42	117.2	4,652	1,288	53,912	404,982	1,497	.321	2.62	8.6	11′ 6″		Used
Total....................................		1,707.23	20,416	11.96	112.4	4,386	7,461	313,439	2,354,572	1,380	.315	2.73	8.25	....	....	
Average..................................		.....	.....	11.96	112.4	4,386	....	......	......	1,380	.315	2.73	8.25	....	....	
Average of five long trips..................		1,306.71	15,681	12.00	112.88	4,406	5,813	244,196	1,834,377	1,402	.318	2.69	8.15	....	....	
Average of four long trips with deep draft.....		1,036.38	12,317	11.89	111.75	4,342	4,525	190,284	1,429,395	1,379	.317+	2.725	8.3	24′ 6⅜″	....	

Elder Dempster's New Passenger Motor-Liner

"Adda," a Harland & Wolff Built Diesel-Driven Vessel of 12,800 Tons, Starts on Maiden Voyage to West Africa

SHIPOWNERS pay the bills, so they are fully entitled to select any class of machinery they see fit for additions to their fleet. Domestic shipowners continue to order steam-driven vessels for passenger service; but this does not alter the fact that big operating economies would have been effected had recently contracted-for ships been equipped with Diesel or Diesel-electric power. British shipowners, who, of course, are the reverse of novices in the running of passenger liners of all sizes and types, are continuing to build motor-vessels, although coal is the only natural fuel to be found in quantities in the British Isles. Whereas, American shipowners have oil right at the doorsteps of their offices, and will have it for many years if they use it conservatively and not waste it under boilers.

After running the large passenger-cargo motorship ABA, ex GLENOGLE, on their West African route, the Elder Dempster Company, Limited, have just taken delivery of the new big passenger motor-liner ADDA, which ran trials on the Clyde on Nov. 14th and sailed from Liverpool on her maiden voyage to West Africa with passengers, mails and cargo on Nov. 29th, and it is expected she will average a speed of nearly 14 knots. Although she carries 331 passengers, 820 tons of fuel-oil and 5,000 tons of cargo, as well as mail, her daily fuel-consumption at sea when averaging 14 knots will not exceed 21½ tons per day with the twin engines together developing 6,000 i.h.p. at 115 r.p.m. and sufficient auxiliaries running to drive all her vast amount of electrical machinery, including 1,300 lights, steering-gear, cabin and saloon radiators, cooking utensils, barber-shop equipment, appliances, laundry, wireless, pumps, ventilating-fans, breeze-fans, etc. She is under command of Capt. James T. Toft, Commodore of the fleet.

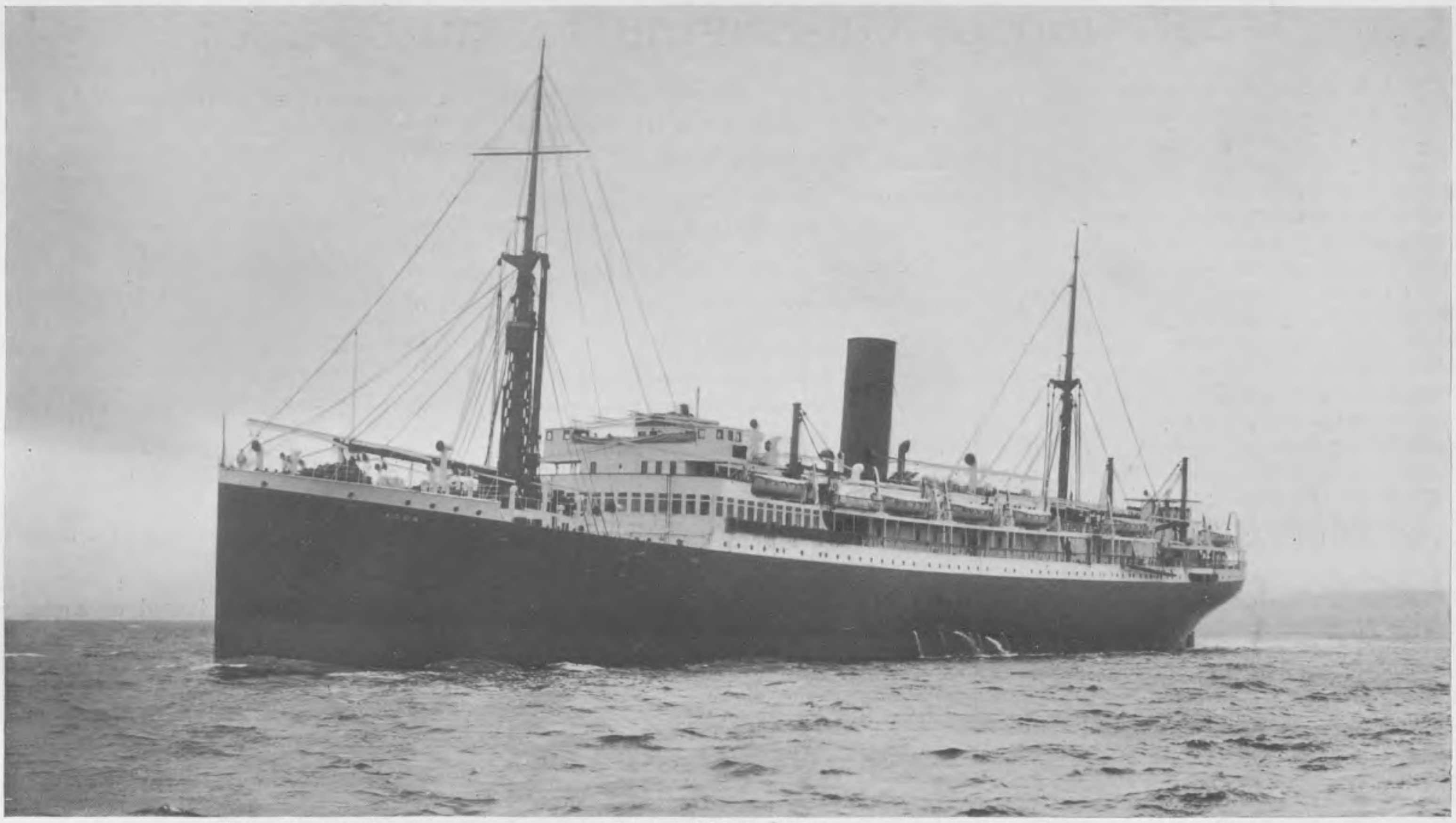
The leading dimensions of the ADDA are as follows:

Displacement . . . . 12,800 tons
Speed . . . . 14 knots
Cargo capacity . . . . . . 5,000 tons
Passenger capacity . . . 331 (225 first, 74 second and 32 third class)
Fuel capacity . . . . 820 tons
Power . . . . 6,000 i.h.p.
Engine & propeller speed . . . . 115 r.p.m.
Length . . . . 450′ 0″
Breadth . . . . 57′ 0″
Depth (M.D. to awning decks) . . . . 34′ 6″
Daily fuel-consumption in port . . . . 1½ to 2 tons
Length of boat deck . . 260′ 0″

She is a most luxurious three-decked vessel in every respect and fully equal to any liner of her size now trading on the Atlantic Ocean. In fact, she is much finer than the majority of such craft, and has a capacity of a steamer of 2,000 tons greater loaded-displacement. Thus, while she may have cost a little more than a steamer of her actual dimensions, she was cheaper than a steamer of the same passenger and cargo capacity and equal equipment.

Her main engines consist of twin eight-cylinder, four-cycle Harland & Wolff-B. & W. Diesel-engines of a standard design, about a dozen of engines of this power having been completed at Glasgow and installed in motorships during and since the war. On the awning deck there is a 100 k.w. Diesel-driven emergency generating-set for light, wireless and power in case of accident completely flooding the engine-room. She is a complete electric ship, about 60 miles of wiring and cable being laid about the vessel.

An elaborate system of fire-fighting appli-



Elder Dempster's new passenger motor-liner "Adda" which represents a much-needed type of motorship

ances is installed both in the passenger and cargo spaces. Chemical fire-extinguishers are distributed throughout, whilst a complete system of fire alarms enables the officer on watch to be at once warned of any outbreak of fire.

Electro vapor radiators are fitted throughout all classes of accommodation and also in the crew's rooms. There is a complete system of call bells and blue light indications throughout the ship.

The electric installation is on the double-wired system, and lead-covered wiring is used throughout, except in those positions liable to exposure, when steel-armored cables are used.

The insulated cargo and stores space is situated in No. 3 hold. The space for insulated cargo and that allocated for ship's stores use are divided by a short orlop deck. There are separate cold chambers for poultry, meat, fish, and fruit.

The preparation of food is carried out under the most hygienic conditions. The equipment in the galleys is of the most modern type. The cooking ranges are oil-fired, and the grills, etc., are electrically heated. Potato-peelers, dish-washers, dough-mixers, etc., are all electrically driven.

A fully-equipped hospital is situated on the docking bridge. The barber's shop is situated amidships on the starboard side of the awning deck. The laundry, this necessary appointment in modern sea-travelling, has been so arranged as to be able to deal with passengers' washing in a most expeditious manner.

The first-class dining saloon is arranged in the most up-to-date restaurant style, having numerous small tables, each accommodating four, six or eight diners. It is a white room, panelled in simple Adam fashion, slightly relieved with gold and delicate Wedgwood plaques, with blue damask hangings.

From the after end of the dining saloon a handsome staircase leads to the public rooms on the decks above. On the landings are the usual accessories of sea-travel, a post box, a chart-track board and direction notices.

The smoking-room is situated on the boat-deck abaft the motor-room casing. It is oak panelled and representative of a reserved interpretation of the English Renaissance. The furniture consists of arm-chairs and chesterfields covered in cow-hide. A special feature of the room is the fireplace and overmantel, which embodies a handsome oil-painting giving the effect of a Medieval tapestry, the subject of which is a hunting picnic taken from a wood-cut in Turberville's "Art of Venerie," circa 1575. The fireplace, with its red-tiled interior and dog grate, contributes considerably to the Medieval atmosphere, as well as to the comfort of the room.

Much care has been devoted to the furnishing of this important public room. It is panelled in sycamore, with richly carved Georgian motifs to its fine lofty windows.

The reading and writing room is representative of Louis XVI period, its panelled walls being painted in shades of pale French gray, with rose-colored hangings to the windows. It is well situated on the boat-deck forward of the smoking-room, and is surmounted by a decorative glass dome.

There are two sets of en suite rooms, each accommodating two passengers, situated on the awning-deck. The rooms have private bathrooms attached, and are fitted with Pullman berths. Each room contains a handsome wardrobe, writing table, and two easy chairs. There are a number of single-berth cabins situated on the bridge-deck.

Many of the double-berthed staterooms are arranged on the tandem principle, thus ensuring that the inside rooms have access to the ship's side.

Each of the first-class staterooms has a fresh water supply at the basin, which is fitted with a discharge, thus eliminating the necessity of a collecting tank.

There is excellent accommodation for the second-class passengers, and this includes a dining-saloon seating 108 persons, smoking-room and two- and four-berth cabins. Similar accommodations, but less pretentious, have been provided for the third class passengers. A system of forced-draft and fans is arranged throughout the ship, nineteen large electrically-driven fans being employed for the main system.

There are 12 cargo winches, all electrically driven. They are of the Laurence-Scott type, and are capable of dealing with loads up to four tons. There is also a powerful warping winch, with large drum ends, which can be used as an emergency steering gear. The derrick gear consists of 20 channel derricks for lifts up to 10 tons.

Every use has been made of scientific instruments in order to assist the officers in navigation. Clay's automatic steering control is fitted to the pedestal in the wheel-house, thus precluding the helm orders transmitted by the officers from any possible error in execution.

A complete installation of Kelvin, Bottomley and Baird's draft pneumercators permits of the exact drafts of the vessel being read direct from the chart-room. There is also an installation of "Bonlow" tank gauges, enabling the capacities of the double-bottom and deep tanks to be read direct from the engine-room. The temperatures of the cold chambers can also be read from the engine-room by means of the "Sentinel" long-distance thermometers.

The ADDA carries sufficient oil in her double-bottom, and also in deep tanks abaft the motor-room, to enable her to make a round trip to West Africa and back without refilling en route. The double-bottom extends right forward and aft. About 820 tons of oil is carried altogether, and this quantity can be taken aboard, under favorable circumstances, in about five hours.

Utilization of Oil-Engine Exhaust Gases

Another Treatise on the Waste-Heat Problem Which Will Be Found More Exhaustive and of Even Greater Value Than the First Article on This Interesting Subject Published in Our October, 1922, Issue

By J. L. CHALONER

THE Problem before many shipowners and shipbuilders to-day is—shall all or part of existing steam auxiliaries be retained when converting steamers to Diesel power in order to reduce costs, or shall oil-engine-electric drive be installed throughout and the steam-plant scrapped? At least three important American superheater manufacturers are working on the problem of utilizing their devices for generation of steam by exhaust-gases from the main Diesel engines. Particularly to these concerns will this article be of great value. Exhaust-gases have been used with success in Dutch and British motorships since 1912 for driving the steering-engine at sea by steam.

FROM time to time some new type of heat engine invites attention. Claims are made, the scantiest examination of which makes it apparent that deductions have been drawn and conclusions have been arrived at without the slightest consideration having been given to even the most elementary principles of thermo-dynamics. In fact, if what the inventor asserts, could be substantiated by practical demonstration, existing methods of heat generation, whether external or internal, are eclipsed continuously and consistently to the extent of anything up to 100 per cent.

With the present state of scientific advancement, one is hardly prepared to accept new principles of heat generation, which must perforce embody revolutionary theorems in order to achieve what they set out to do. There appears to be the impression in some quarters that thermo-dynamical principles may be ignored or overridden provided that the new heat generator or prime mover is blessed with a liberal amount of mechanical complications.

From the very inception of the internal-combustion engine its history has proved that simplicity is the keynote to success, an axiom which inventors would be wise to recognize. In some cases which have come before our notice it was quite obvious that the engines had at the time of the claim not even got past the "drawing-board" stage. Whether lack of finance or absence of courage was the reason one cannot say. The fact remains, however, that their inventors are still alive, which makes it apparent—at any rate to us—that no actual engine was ever tested in their presence. Carnot's cycle, although not one to be applied in a practical design, indicates the limit of maximum efficiency of any heat cycle with the following relations:

$$\eta \max = \frac{Q_1 - Q_2}{Q_1}$$

where

Q_1 is the total heat received during the cycle,

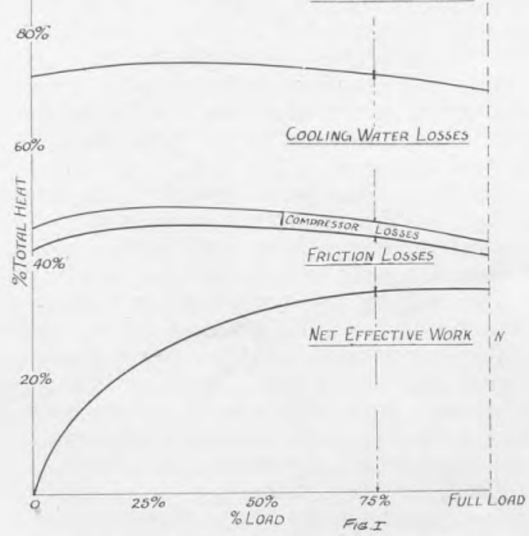
Q_2 is the total heat rejected during the same cycle,

and

η is the efficiency of the cycle.

We have got within 70 per cent (on an indicated thermal efficiency base) of this maximum useful heat exchange with the mixed cycle, in which combustion takes place partially at constant volume, partially at constant pressure, and which employs a high compression ratio. It has been proved also that by making certain corrections, chiefly concerned with specific heats at high temperatures, that we are today actually within 20 per cent of the ideal—that is, the maximum possible—efficiency. In accordance with the laws of thermo-dynamics, as they present themselves to us at present, we have, therefore, only very limited scope for improving the efficiency of the modern oil engine. The oil turbine of today forms practical proof of this argument.

Examining for a moment the heat balance sheet of an oil engine, it will be seen that the greater portion of the available heat relative to the heat usefully employed is carried away by the cooling water and the exhaust gases. Hence, if there exist an avenue which might be exploited to advantage it should be in the direction of the possible utilization of the heat carried to waste by the circulation water and exhaust gases.



Average heat-balance sheet showing distribution of losses for various loads expressed as percentage of full-load

It is not our intention to give the impression that with the above reasoning we attempt to propound a new theory or introduce some startling innovation. We would state that this loss of heat energy has had the attention of all interested parties since the very beginning of the internal combustion era. As a matter of fact, in the days of the gas engine there was even more scope owing to the lower efficiency of the Otto cycle. The difference in a broad classification of the heat energy and its distribution may be seen from Table No. I:

TABLE NO. I.

Type of Engine	Gas-Engine	Oil-Engine
Useful heat......	36% to 35%	42% to 46%
Exhaust heat.....	39% to 36%	25% to 24%
Cooling Water...	25% to 29%	33% to 30%
Total.......	100%	100%

No doubt many an engineer has given the utilization of this waste heat his consideration, and we suggest that a useful purpose will be served by a discourse on this important subject. A presentation of pertinent technical data is bound to be interesting and instructive, even if only from a general knowledge point of view. It is hoped that the following discussion will act as a guide—or as a brake, as the case may be—to those sea-going engineers, who in their spare moments would like to calculate for themselves how much bunker they carry for which they get no effective return.

The Heat Balance Sheet of an Oil Engine

For the purpose of establishing a fairly wide base for our proposed investigation and furthermore to prove some of the conclusions which we hope to establish, we have prepared in Tables Nos. II, III and IV a number of heat balance sheets, which cover practically every type of engine which it may be deemed advisable to examine from the point of view of wasted heat utilization.

With the object of simplifying matters the speed has been taken as the classification factor, and thus it will be seen that Table No. II refers to engines running at 350 r.p.m. and over, Table No. III deals with engines working with a speed between 300 and 150 r.p.m., while finally in Table No. IV engines of 125 revolutions and lower are dealt with. In each case the units are arranged in order of horse power rating per cylinder, which arrangement would call for the assumption—quite a reasonable one to make—that all cylinders are working under similar conditions as far as each unit is concerned. In Fig. No. I is shown what might be considered an average heat balance sheet, and the graph has been arranged in such a way as to indicate the distribution of the losses for various loads expressed as a percentage of full load.

As will be seen, we are mainly concerned with the heat passing away in the exhaust gases and the cooling water, and as the former presents rather more difficulties in arriving at some practical conclusion, we propose to deal with that part of the heat loss first.

Exhaust Gases and Their Heat Value

For the purpose of calculating the potential heat of any substance we take the product of the weight of the substance, its specific heat and temperature. In order, therefore, to find the available heat in the exhaust gases we must know their weight or volume, we must have an analysis in order

to determine the specific heat of the products of combustion, and finally we must have the temperature of the gases on leaving the engine cylinder.

Exhaust Gas Temperatures

The temperatures of the exhaust gases are quoted in several cases on Tables No. II, III and IV. These figures only act as a general guide of the temperatures to be expected, as on closer examination there is apparent inconsistency between the temperatures for the different types. It must be remembered that the results were obtained by a number of observers, who used different measuring devices in different positions relative to the exhaust valve or port.

Again the shape of the combustion chamber, the atomizing device, the degree of combustion, the grade of fuel are only a few of the many factors which determine the actual temperature of the gases on leaving the cylinder.

Load conditions, general design and test methods are obviously not uniform and thus affect the results to a definite degree. For instance, the heat transference varies with the speed; it is obviously greater with slower speed. Again the ratio of cooled surface to cylinder volume controls the relative amount of heat passing into the gas and cooling water, more heat being absorbed by the water with an increasing ratio of surface to volume. The speed of the engine has a specific influence on the exhaust temperature, the latter varying inversely as the speed.

Available heat is somewhat higher for the two-cycle engine than for the four-cycle, as might be anticipated. The tables, however, do not bring out this point as positively as one might desire, the net difference being only about one per cent. The reason is most probably found in the influence which the scavenging air, both with regard to volume and pressure, exercises over the exhaust.

Slight variation in heat distribution for small and large cylinders is interesting and bears out the general experience that in the oil engine a relatively large increase in cylinder dimensions does not mean a decrease of fuel consumption per unit of similar dimensions.

Mean-effective pressure has a definite relation to the exhaust temperature not only for two engines running at the same speed, but also for the same engine at reduced power. In Table No. V a number of test data are quoted for various loads expressed as a percentage of normal rating.

These temperatures for the four engine

TABLE NO. II.

HIGH SPEED ENGINES

Unit No.	1	2	3	4	5	6	7
Type and Size	5 B. H. P. 4-cycle	225 B. H. P. 4-cycle	450 B. H. P. 4-cycle	450 B. H. P. 4-cycle	450 B. H. P. 4-cycle	1,650 B. H. P. 2-cycle	1,700 B. H. P. 4-cycle
Cylinder Dimension (in M/m.)	116x150	250x350	330x400	320x420	315x430	450x500	530x530
Speed (Revs. per min.)	600	400	405	400	400	350	370
B. H. P. (per Cylinder)	4.76	39.6	74	74	74	275	281
M. E. P. (Lbs. per sq. in.) B. H. P.	63.5	73.7	68.7	70.0	69.3	66.0	84.0
M. E. P. (Lbs. per sq. in.) I. H. P.	109.0	114.0	96.2	104.5	99.0	106.5	118.0
Heat Balance: E. H. P.	25.6	27.8	31.8	31.5	31.3	26.8	29.9
Heat Balance: Mech. Losses Friction	.....	.....	.....	.....	8.7	.....	8.6
Heat Balance: Mech. Losses Compressor	18.2	15.2	12.8	15.5	4.5 13.2	16.4	3.5 12.1
Heat Balance: Cooling	26.8	28.6	36.8	34.3	37.3	26.6	26.3
Heat Balance: Exhaust	29.4	28.4	18.6	18.7	18.2	30.2	31.7
Heat Balance: Total %	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Compression Pressure (lbs. per sq. in.)	461	.....	570	520	.....	496	525
Compression Ratio	.....	.....	15.7	15.6	.....	.....	15.6
Air Excess Co-efficient	.....	.....	.....	.....	.....	1.60	1.4 3
Exhaust Temperature (°Fahr.)	686	.....	.....	.....	.....	885	930

units can only be compared with each other by making such corrections as become necessary in view of what has been said previously with regard to the influence of various factors. An examination of the particulars on Table No. IV with specific reference to the four units mentioned in Table V will be an advantage:

TABLE NO. V.

Unit No: (see Table No. IV.)	Exhaust Temperatures °F. @ % Full Load. 110%	100%	75%	50%	25%	Type
3	594	540	470	401	342	4–stroke
9	584	459	368	302	240	2–stroke
10	756	678	579	494	...	2–stroke
12	635	590	500	397	284	2–stroke

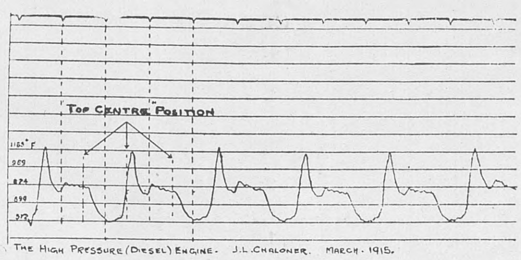


Fig. 2. Temperature variations over six complete cycles at full-power

Some actual measurements by Woolf are very interesting and instructive in this connection. It must be remembered, however, that the engine was only rated at 40 B.H.P. (12.5 inches diameter by 19 inches stroke), the speed being 190 r.p.m. The temperatures were obtained by direct measurement; a pyrometer was fitted into the combustion chamber on the exhaust valve side. The recording terminal was 1/8-inch long and about 1/8-inch distant from the cylinder wall. It was secured in a position parallel to and 1 1/8-inch from the under side of the cylinder cover. Continuous temperature records were taken under different load conditions, and in Fig. 2 we reproduce a chart showing the temperature variations over six complete cycles with the engine developing full power. Fig. 3 shows an enlarged view of the exhaust stroke, and indicates the gradual and comparatively small drop in the temperature throughout the exhaust stroke.

Specific Heat of Exhaust Gases

The fuel being a hydro-carbon, one may expect the composition of the gases to include CO_2, O and N as the main constituents, with SO_2, H_2O and possibly CO in small quantities. Here again we resort to the use of two tables to indicate the conditions as they exist under various loads. Speed, load and atmospheric conditions on one hand, grade of fuel and air excess co-efficient on the other are responsible for the percentages of the various constituents.

Direct air measurements and calculations of the excess air co-efficients from the exhaust-gas analysis agree so closely together as to make the latter method sufficiently accurate for all practical purposes. This is an important concession in view of the simple and familiar way, in which exhaust gas tests are carried out. One must remember that only four-cycle engines can be dealt with in this simple manner, and that in the case of the two-cycle engine careful calculations of the scavenging-air quantities must be made. In Tables No. VI and VII two sets of exhaust-gas analyses are quoted for various parts of the full load output of the engine.

TABLE NO. VI.

Composition of gas (by weight)	Full load	3/4 Load	1/2 Load	1/4 Load
CO_2	15.10	11.28	7.35	4.85
CO	0.00	0.00	0.00	0.01
H_2O	4.97	3.73	2.40	1.60
SO_2	0.16	0.11	0.07	0.03
O_2	4.77	8.78	13.03	15.72
N_2	75.00	76.10	77.25	77.80
Air Excess	1.45%	1.96%	3.05%	4.67%
Specific Heat of gas	0.248	0.247	0.244	0.242

Note:—The oil used during this test was 25° Baume.

TABLE NO. III.

Engine Unit No.	1	2	3	4	5	6	7	8
Size and type	8 H. P. 4-cycle	12 H. P. 4-cycle	15 H. P. 4-cycle	50 H. P. 4-cycle	30 H. P. 4-cycle	45 H. P. 4-cycle	50 H. P. 4-cycle	60 H. P. 4-cycle
Cylinder Dimension (in M/m.)	165x 269.6	185x 320.7	215x 340	255x 388	260.1x 400.3	290x 452	310x 463	375x 550
Speed (Revs. per minute)	270.3	277	235	229	179.8	179	245	166
B.H.P. (per Cylinder)	8.62	12.14	15.56	25.3	30.8	38	47.8	60.3
M. E. P. (lbs. per sq. in.) B.H.P. (Base)	73.0	65.3	68.6	72.7	67.7	73.8	77.0	77.0
M. E. P. (lbs. per sq. in.) I.H.P. (Base)	94.4	87.0	96.0	103.0	94.0	104.0	106.0	103.0
Heat Balance: Effect. Horse-Power	27.6	26.0	28.9	32.4	27.2	29.3	30.5	33.7
Heat Balance: Mech. Losses Friction	6.7					9.3	7.5	
Heat Balance: Mech. Losses Compressors	2.6 9.3	8.6	11.3	13.5	10.4	2.8 12.1	4.0 11.5	11.3
Heat Balance: Cooling water	18.2	34.9	30.7	30.3	21.9	26.0	25.4	28.0
Heat Balance: Exhaust Gases	44.9	30.5	29.1	23.8	40.5	32.6	32.6	27.0
Heat Balance: Total percentage	100	100	100	100	100	100	100	100
Compression Pressure (lbs. per sq. in.)	490	425	495	495	.....	485	490	.....
Compression Ratio	.....	14.36	11.58	.....	.....	15	15.3	.....
Air Excess Co-efficient	.....	1.93	1.90	.....	1.92	1.8	1.45	.....
Exhaust Temp. (°Fahr.)	.....	653	780	.....	722	710	535	.....

Engine Unit No.	9	10	11	12	13	14	15	16
Size and type	120 H. P. 4-cycle	200 H. P. 4-cycle	70 H. P. 4-cycle	200 H. P. 4-cycle	500 H. P. 4-cycle	1000 H. P. 4-cycle	800 H. P. 4-cycle	1000 H. P. (double acting) 4-cycle
Cylinder Dimension (in M/m.)	380x 560	370x 560	400.5x 600.5	430x 670	510x 610	550x 800	660x 840	740x 1000
Speed (Revs. per minute)	180.1	188.2	158.8	160.5	200	151	145	124.9
B.H.P. (per Cylinder)	63.2	66.5	69.63	98.9	123.8	167.8	196.5	501.0
M. E. P. (lbs. per sq. in.) B.H.P. (Base)	70.0	76.0	73.8	81.0	64.5	76.0	60.0	66.9
M. E. P. (lbs. per sq. in.) I.H.P. (Base)	91.0	94.0	96.0	106.5	85.0	98.0	78.0	85.0
Heat Balance: Effect. Horse-Power	33.8	33.6	31.9	34.2	34.2	35.6	34.8	29.5
Heat Balance: Mech. Losses Friction	6.9	8.8	7.5					
Heat Balance: Mech. Losses Compressors	2.9 9.8	2.3 11.1	2.1 9.6	10.9	10.8	10.2	10.4	8.2
Heat Balance: Cooling water	24.8	27.2	27.6	26.5	26.3	26.6	25.7	36.6
Heat Balance: Exhaust Gases	31.6	28.1	30.9	28.4	28.7	28.6	29.1	25.7
Heat Balance: Total percentage	100	100	100	100	100	100	100	100
Compression Pressure (lbs. per sq. in.)	460	.....	490	503	485	500	505	465
Compression Ratio	15.4	.....	15.4	.....	15.3	.....	15.4	.....
Air Excess Co-efficient	.....	.....	.....	.....	.....	.....	.....	.....
Exhaust Temp. (°Fahr.)	.....	.....	645	752	.....	680	.....	563

TABLE NO. IV.

Unit No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Size and Type	1,500 I. H. P. 2-cycle	1,620 I. H. P. 4-cycle	1,600 I. H. P. 4-cycle	2,330 I. H. P. 4-cycle	2,000 I. H. P. 4-cycle	2,140 I. H. P. 4-cycle	1,580 I. H. P. (opposed-piston) 2-cycle	2,240 I. H. P. 4-cycle	1,700 I. H. P. 2-cycle	1,400 I. H. P. (Still) 2-cycle	3,200 I. H. P. 4-cycle	2,000 I. H. P. 2-cycle	3,900 I. H. P. 2-cycle	3,000 I. H. P. (opposed-piston) 2-cycle
Cylinder Dimensions (in ins.)	18"x 37"	24½"x 39"	24⅜"x 38⅜"	26½"x 47"	25¾"x 39⅜"	26¾"x 47¼"	18½"x 25"	30"x 48"	23⅝"x 37"	22"x 36"	29⅛"x 45¼"	26⅝"x 36¼"	25½"x 48"	22¾"x 45½"
Speed (Revs. per minute)	115	118	124	96.5	125	100	115	105	102.2	125	115	105.4	100	76.2
B.H.P. (per Cylinder)	188	208	211	225	233	266	300	308	316	327	328	403	450	635
M.E.P. (lbs. p. sq. in.) B.H.P. (Base)	69.0	76.0	75.5	71.0	72.0	82.0	77.0	68.5	74.0	75.8	75.0	75.0	73.0	88.2
M.E.P. (lbs. p. sq. in.) I.H.P. (Base)	92.0	99.0	98.0	99.0	99.0	110.0	101.0	82.0	102.2	91.4	91.5	92.5	105.0	109.4
Heat Balance: Effect. Horse-Power	31.0	33.0	33.6	33.0	33.2	33.1	31.4	32.9	33.0	(39.9) 31.0	33.3	35.4	31.4	34.5
Heat Balance: Mech. Losses: Friction	.....	.....	.....	.....	.....	.....	.....	.....	.....	..... (9.1)	.....	.....	.....	.....
Heat Balance: Mech. Losses: Compressor	10.3	10.0	10.2	13.4	12.4	11.3	9.9	6.8	12.6	11.0	7.3	8.4	13.8	8.0
Heat Balance: Cooling Water	.....	.....	.....	.....	.....	.....	.....	.....	.....	Condenser(40) 20.0	.....	.....	.....	.....
Heat Balance: Exhaust Gases	58.7	57.0	56.2	53.6	54.4	55.6	58.7	60.3	54.4	(11) 38.0	59.4	56.2	54.8	57.5
Heat Balance: Total %	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Compression: Press. lbs. p. sq. in.	490	.....	500	495	510	500	495	.....	.....	300	.....	426	.....	300
Compression: Ratio	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Air Excess Co-efficient	.....	.....	.....	.....	1.58	.....	.....	.....	.....	.....	.....	.....	.....	.....
Exhaust Temperature (°Fahr.)	.....	600	550	653	.....	.....	.....	.....	464	678	.....	600	.....	570

TABLE NO. VII.

Exhaust gas (by weight)	Over-load	Full Load	¾ Load	½ Load	¼ Load	No Load
CO_2	13.9	11.2	9.1	6.8	5.4	3.4
CO	....	....	....	....	....	....
H_2O	5.6	4.6	3.9	3.1	2.8	1.6
O_2	7.6	11.2	13.0	15.5	18.6	19.3
N_2	73.0	73.0	74.0	74.6	75.0	75.7
Air Excess	1.53%	1.9%	2.35%	3.2%	3.95%	6.5%
Specific heat of gas	0.260	0.256	0.253	0.249	0.247	0.243

Note:—The oil used during these tests was 29° Baumé.

Attention is drawn to the fact that the above analyses are determined on a gravimetric scale. In passing it may be useful to recall that air consists of 79.16 per cent of nitrogen and 20.84 per cent of oxygen by volume, but 76.85 per cent of nitrogen and 23.15 per cent of oxygen by weight. Whilst it is rather difficult to give any typical illustration of gas analyses for two-cycle and four-cycle engines, Table No. VIII has been prepared with a view to indicate what the results might be expected to be, provided normal conditions are retained. The figures refer to Engine Units Nos. 5 and 12 on Table No. IV, and the comparison is very instructive and interesting.

Values for specific test are added, and we have assumed a temperature of 1,200 degrees Fahrenheit as the exhaust gases leave the combustion chamber. The specific heats and specific weights are the values for this temperature.

TABLE NO. VIII.

Exhaust gas Analysis

Volumetric % of Constituents	4–stroke marine engine	2–stroke marine engine	Specific Heat (constant pressure)	Specific weight lb. p. cbft.
CO_2	9.0	5.0	0.240	0.0385
CO	0.0	0.1	0.251	0.0245
H_2O	2.0	2.0	0.480	0.0160
SO_2	0.1	0.1	0.260	0.0560
O_2	7.0	12.0	0.230	0.0280
N_2	81.9	80.8	0.247	0.0246
Air (for comparison)	....	....	0.238	0.0253
Mean specific heat of gas	0.2498	0.2497	....	......
Mean specific weight of gas	0.0281	0.0276	....	......

Weight of Exhaust Gases

During the chemical process of combustion the carbon and hydrogen in the oil combine with the oxygen in the air. As in the case of coal, therefore, a definite amount of air must be provided to produce complete combustion.

Owing to the conditions inside the combustion chamber, it is found that the amount of air, calculated in the usual way from the analysis of the oil, is not sufficient to produce the desired degree of combustion. As in the case of coal, a certain additional volume must be provided for over and above the theoretical amount. As has been noted, this amount is not as large as is found necessary with coal. The calculations for air requirements are quite simple and no reference is deemed necessary at this stage.

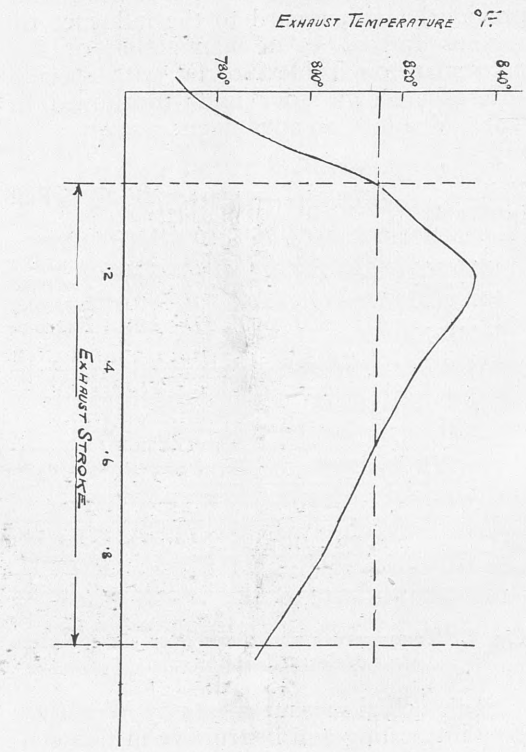


Fig. 3

Curve of temperature readings throughout exhaust stroke

One may like to compare one's coal results with the modified conditions when using oil, and here one must remember several important differences between oil and coal.

The hydrogen contents are 5 per cent for coal, but 12 per cent for oil.

The maximum possible percentage of carbonic acid varies as the hydrogen carbon ratio, and in this lies the explanation of the comparatively low percentage of CO_2 as indicated in Tables VI, VII and VIII. Take a pound of coal, dried and ash-free, having 80 per cent carbon and 5 per cent hydrogen. The maximum percentage of CO_2 possible is, say, 18¼ per cent.

A pound of oil, free from water and mechanical impurities, has 84 per cent carbon and 12 per cent hydrogen.

The highest possible yield of CO_2 would not exceed 15¾ per cent.

For the oils which are used for marine oil engines the hydrogen content varies from 11 to 12 per cent; the corresponding carbon is 82 to 84 per cent.

It will thus be seen that the theoretical amount of air is between 13 and 14 pounds, or 160 to 175 cubic feet (free air at 60 degrees Fahrenheit).

Calculations will reveal that for an oil of 34 degrees Baumé about 14 pounds of air are required, and that a 24-degree Baumé grade requires about 13 pounds. As the gravity increases, so the amount of air becomes less. As to the excess air we find from a large number of tests with different engines that 80 and 100 per cent for four-cycle and two-cycle types respectively gives the best all-round results. Expressed as excess air co-efficients increase in proportion to the values quoted in Tables Nos. VI and VII. For the purpose of an approximation of the weight or volume of exhaust gases we suggest the following:

$$H.P._B = \frac{P.L.A.N.}{33000} = \frac{P_B}{3.8} \quad \frac{(L.A.N.)}{(144\ \ 60)}$$

$$= \frac{P_B}{3.8} \times V_A$$

Where V_A = volume of air per sec. (if volumetric efficiency is 100%)

$$\therefore V_A = \frac{H.P._B \times 3.8}{P_B}$$

Where $H.P._B$ = B.H.P.

P_B = 65 for 2–stroke
70 for 4–stroke

$\therefore$ V_A = 0.058 H.P. cu. ft. per sec. (2–cycle)
V_A = 0.054 H.P. cu. ft. per sec. (4–cycle)

We may say that:—

$$2\ V_A = V_E$$

hence

V_E = 0.116 H.P. cu. ft. per sec. (2–cycle)
V_E = 0.108 H.P. cu. ft. per sec. (4–cycle)

where V_E = volume of exhaust gases.

To illustrate the above, we will quote the following example:—

B.H.P. . . . . = 3,000

Fuel Consumption = 0.42 lb. per B.H.P. hour.

Theoretical air per lb. of fuel . . . . . = 14 lbs.

Air excess co-efficient . . . . . = 1.8

Mean specific weight of exhaust gas (see Table No. VIII) = 0.281

$\therefore$ Volume of Exhaust per sec. $= \dfrac{3{,}000 \times .42 + 3{,}000 \times 0.42 \times 25.2}{60 \times 60 \times 0.281}$

= 326 cu. ft. per sec.

Using above formula Volume of Exhaust Gas . . . = 0.108 x 3,000
= 324 cu. ft. per sec.

(Continued on page 24)

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MOTORSHIP

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CONVERSION OF THE SHIPPING BOARD'S STEAMERS

In our December number there was published, with discussions, a paper read by Mr. J. L. Ackerson before the November meeting of the American Society of Naval Architects and Marine Engineers, entitled "Selecting the Best Kind of Propelling Machinery." The points in the paper, under controversy, and as pertaining to motorships, were well covered in the discussions, so we will confine our remarks to steamship conversion features; in which we think Mr. Ackerson seriously errs. From the figures submitted he claims that the conversion of Shipping Board tonnage, now hanging on the market and available to prospective purchasers at low figures, is only justifiable for the long voyages, or provided the vessels can be purchased for conversion at $30 per ton deadweight less than would be paid to continue as steam vessels. As $30 is the generally accepted figure which the Emergency Fleet tonnage is expected to bring in the open market,—although this may be increased to $35, it is equivalent to saying that the vessels would have to be presented to owners as gifts to make them profitable when converted to motorships. As a matter of fact, for conversion purposes the Board will sell some of them at $5 to $7 per ton.

Apparently Mr. Ackerson has arrived at his conclusions by using good general assumptions and by failing to take all factors into consideration. While he briefly refers to what is the most important claim for oil-engine drive, namely, enabling a hull to carry 10% to 15% more cargo than any form of steam propulsion, Mr. Ackerson has completely omitted in his tables to include in terms of dollars the results of possible earnings thus derived. Of course, exact estimates are not feasible, but a certain sum should have been included, and as this was not done his figures naturally are misleading. This greater capacity is due, as is common knowledge, to smaller engine-room space of the motorship, and the dispensing with deep-tanks, and the reduction in the amount of fuel-oil and fresh-water to be carried; also, with many designs of oil engines, reduced machinery weights.

Mr. Ackerson also omitted to take into consideration the great variation in vessels constructed during the war emergency, both as to hulls and machinery, and which determines to a large extent the present feasibility of conversion. Some of these craft have not only unreliable and inefficient steam machinery, but very poor hull forms, and drive hard. These will either have to be entirely scrapped, or used in some non-competitive trade where there is no premium on efficiency or operation. There are others that have excellent hulls for driving, and are powered either with fairly satisfactory and reliable steam equipment, or have machinery that is both inefficient and unreliable. It is the vessels having the inferior grades of steam-machinery that we are particularly concerned with at present for conversion—and there are many of them!

A great majority of the vessels that have been tied-up in large numbers for the past two years or more will require a considerable expenditure of money to be put into first-class running condition, regardless whether the steam plant is retained or Diesels installed.

In many cases it will be found necessary to replace the present steam winches with new winches, and many of the deck fittings will have to be renewed. This, with drydocking, scaling of hull, repairs to quarters and propelling machinery, towage, etc., will easily add another $10 per ton, making the steamer, ready for service, a total of $40 per ton to the owner (assuming she was purchased at the beforementioned $30, "as is, and where is"). The value of the steamer after re-conditioning, furthermore, would not be materially enhanced, as the machinery still would be old and out of date, reducing thereby the useful number of years it would be in service. The motorship, on the other hand, would be practically new, due to having entirely new machinery, and of the very latest type, representative of the art of marine Diesel-engine construction.

The motorship would have a much longer number of years of useful service, making for a correspondingly lower depreciation expressed in percentage of the first cost. Assuming, as is practical, the steamer to have a useful life of 10 years and the motorship 20 years, the depreciation is 10% and 5% respectively. The upkeep of the motorship, including deck machinery, will also be considerably less for the motorship, based on actual experience in the operation of steam ships and motorships. As to the saving in cost of engineer personnel, Mr. Ackerson unfortunately has not credited the motorship with this, stating that it is balanced by the motorship's larger consumption of lubricating-oil. This is incorrect, as the single-screw motorship, having one engine, will consume no more lubricating-oil than the single-screw steamer. The motorship, accordingly, should be credited with the full saving of the wages and keep of the firemen of the steamer, amounting to $5,000 per annum as a minimum figure.

Using the figure of $550,000 (as given by Mr. Ackerson) for the total cost of conversion of a steamer of 10,000 tons, deadweight, and 2,500 shaft h.p., and which includes new electrical deck-machinery, modifications and re-conditioning of hull, it will be seen that the cost of the motorship will come out $850,000, which can be conservatively reduced to $800,000—on the assumption that conversion will be made on a number of vessels. This figure, however, is based on the assumption of the motorship hull being purchased at $30, or some as for the steamer, with no allowance being made for the scrap value of the old machinery removed.

The cost of the steamer would be $400,000, or just half that of the motorship. For the purpose of this discussion we will temporarily forget that the Board will sell hulls for conversion purposes at $5 to $7 per ton, in case a change in this ruling is made in the near future. Therefore it will be noted that Mr. Ackerson has arrived at his final conclusions as to conversion by balancing the so-called extra fixed charges (depreciation and insurance) against the saving in fuel consumed by the motorship, apparently assuming that this is the only benefit of motor power.

These fixed charges he has taken as 15%, which is approximately correct for the steamer, assuming 10% for depreciation and 5% insurance. For the motorship this should correspondingly be 10%, due to the depreciation being only 5%, as before stated. The interest charges on borrowed capital should not be included in the fixed charges but taken care of when computing the final net earnings on invested capital. The fixed charges of the motorship accordingly are $80,000, as against $60,000 for the steamer, with a net difference of $20,000 in favor of the steamer instead of $83,000, as given by Mr. Ackerson. Subtracting this from the $53,000 for difference in fuel expenditure, as given, and crediting the motorship with $5,000 for engine-room crew, makes a total net saving of $38,000 for the motorship, which, at 6% interest, represents $630,000 capital, or $230,000 more than the extra cost of the motorship over the

steamer. In addition, there is to be considered the all-important increased earning capacity of the motorship due to its ability to carry more cargo, as previously mentioned. Space does not permit of working out definite routes to show the final net earnings that can be effected in terms of capital invested, which has so frequently been given, from time to time, by those able to do so, included in the pages of this publication. But if such benefits can be gained by buying hulls at $30 per ton, how much greater they will be if purchased at $5 per ton and converted.

ANNOUNCING OUR STATIONARY OIL ENGINE JOURNAL

THE Miller Freeman organization, publishers of MOTORSHIP, are establishing a stationary oil engine journal. It will be known as OIL ENGINE POWER and will appear January 15th, 1923.

Interest has grown to a point where the creation of a central source of information about oil engines should be helpful to engine manufacturers and users as well as highly beneficial among prospective buyers.

Constant pressure for greater economy of operation and a growing desire to learn more about the subject makes it desirable to establish a special medium to illustrate the commercial uses of oil engines and present the facts about their economic advantages.

There are several splendid technical publications already in the power field and they print some oil-engine matter from time to time. However, they are published chiefly in the interests of steam and hydro-electric plants.

OIL ENGINE POWER is being established as the active champion of the stationary oil engine. We will conduct it without fear or favor as the undivided exponent of this form of power in all cases where its use is economical and advantageous. Its purpose will be educational. Its policies will be shaped with an open mind.

OIL ENGINE POWER will be read by the present owners and operators of oil engines and the owners of other types of plants where oil engine installations are practical, including public utilities, central stations, electric railways, municipal water and light plants, flour and cement mills, oil and pipe-line companies, refrigerating plants, mines, general industrial plants, consulting-engineers, and operating-engineers. The broad character of the editorial program will include much technical and semi-technical material of interest and value to MOTORSHIP readers.

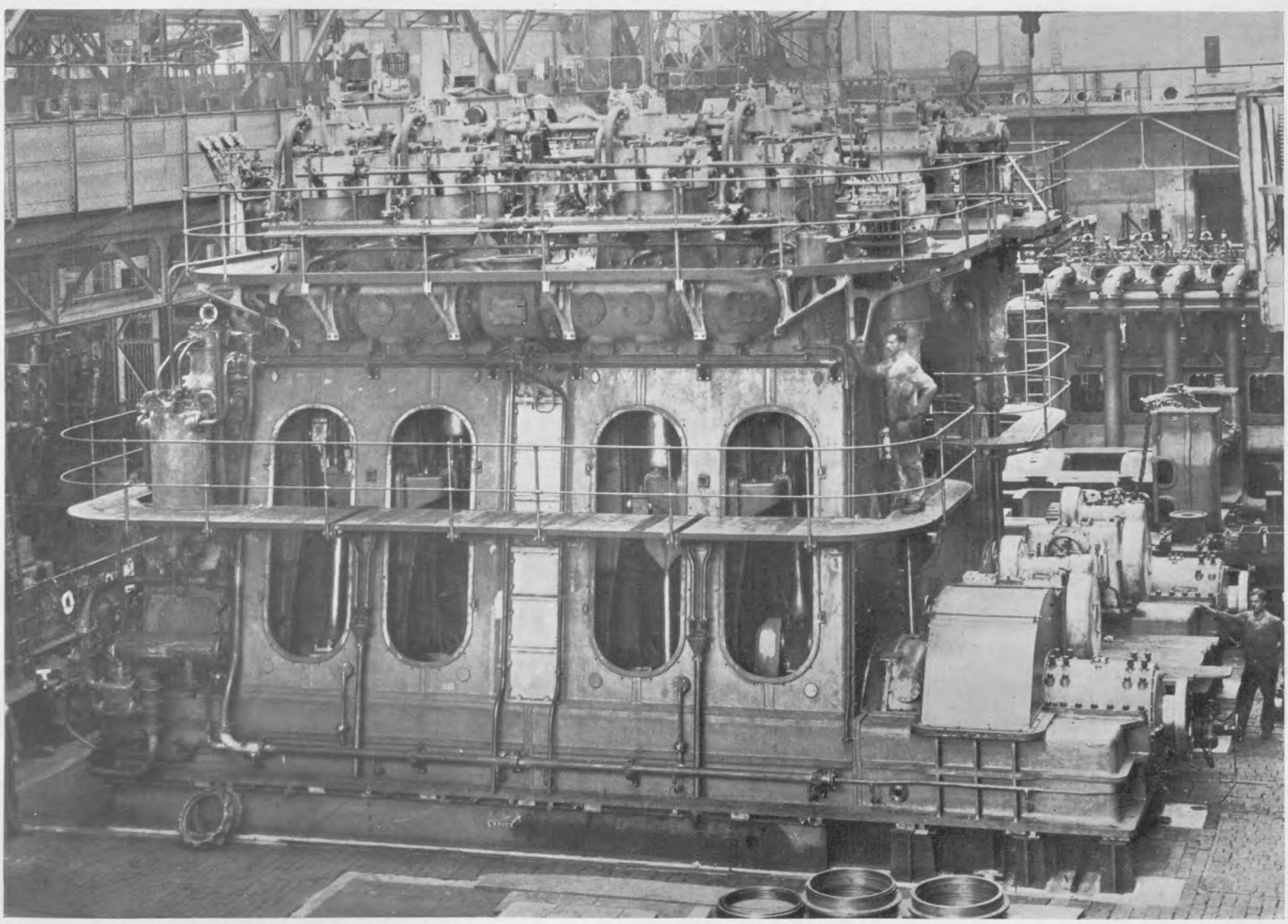
ACCIDENT ON MOTORSHIP "FRITZOE"

On page 34 of this issue will be found the true facts connected with the recent regrettable accident on the motorship FRITZOE. Pending a complete investigation at which the injured engineers can testify MOTORSHIP feels that these facts as now known should be placed before our readers that they may have as clear an idea of what happened as is possible at this writing.

Newspaper accounts of such accidents broadcasted among the public tend to create the feeling that Diesel-engines are dangerous because of high-pressure air-systems, whereas those intimately acquainted with Diesel-engines and motorships realize that accidents from this system are exceedingly rare.

The true cause of the accident on the FRITZOE was ignorance as to what can and what cannot be done with oxygen bottles. These should never be used in connection with oil or with a Diesel-engine, as oxygen coming in contact with oil produces a violent explosion; no ignition of the mixture is required.

Such mistakes as occurred in the case of the FRITZOE are frightful in their results, and we trust that this accident will be an object lesson to engineers and shipyard employes working with oil and with oxygen. We also hope that it may lead to further study of their effect upon each other so that such an accident will never be repeated.



Twin Sulzer Diesel-engines of the French motorship "Camranh," developing 1,700 shaft h.p.

Electrical Machinery of the U. S. Army Hopper-Dredges

Description of the Westinghouse Plant Installed in Conjunction with McIntosh & Seymour Diesel Engines in Four Ships Now Building for the Sun Shipyard

FOUR of the most interesting vessels of the past twelve months, namely, four sea-going Diesel-electric hopper-dredges, are now being built at the Sun Shipyard at Chester, Pa., to the order of the U. S. War Department. General arrangement plans and a preliminary description of these craft were first published on pages 516 and 517 of our July, 1922, issue. We are enabled to publish a description of her electrical machinery, which is being manufactured by the Westinghouse Electric and Manufacturing Company. On these vessels, the U. S. Engineers Corps, who were the designers, arranged for electricity to be used for every possible purpose. It will propel the ships and steer them; it will operate the huge dredging pumps and all of the auxiliary machinery; it will supply heat in winter, cool breezes in summer, and ventilation at all times; and it will furnish hot water and do the cooking. Quite literally, there will be no fires of any kind aboard.

These dredges are intended for harbor work and are to be thoroughly sea-worthy. They are to have a length overall of 268 feet 5 inches, molded breadth of 46 feet, draft of 19 feet 6 inches, and total deadweight carrying-capacity of about 2,000 tons. Midships in each vessel there is a well 56 feet long and 7 feet wide, in which the suction-pipe of the dredging pump is suspended. This pipe is 26 inches in diameter and 50 feet long. It is carried by a ladder and is so arranged that the intake end can be lowered into the silt to be removed. The dredging pump is of the 26-inch, volute-centrifugal, single-suction type. It discharges into hoppers located on either side of the well which have a total capacity of 1,250 cubic yards per ship. When the hoppers are filled, the dredge proceeds to the open sea and empties them by means of doors in the bottoms.

The main engines of each dredge consist of three 1,000-B.H.P. McIntosh & Seymour crosshead-type Diesel engines, each of which will be directly connected to a 700-k.w., 500-volt direct-current Westinghouse electric generator of 150 R.P.M. These generators will furnish the power for operating the propellers and the dredging pump.

Each dredge is to be propelled by twin screws, and each propeller is to be direct-connected to 800-horsepower, 480-volt, direct-current Westinghouse motor of the double-armature type. The speed of these motors can be varied from 90 to 110 R.P.M. The main dredge pump is to be driven by a 750-horsepower, 480-volt, direct-current Westinghouse motor, which has a speed variation of from 135 to 160 R.P.M.

The windings of both generators and motors will be impregnated with moisture-resisting compounds and enclosed by protecting covers. Forced ventilation will be provided by small, motor-driven blowers.

Four special advantages will be gained by the use of Diesel-electric drive on these dredges.

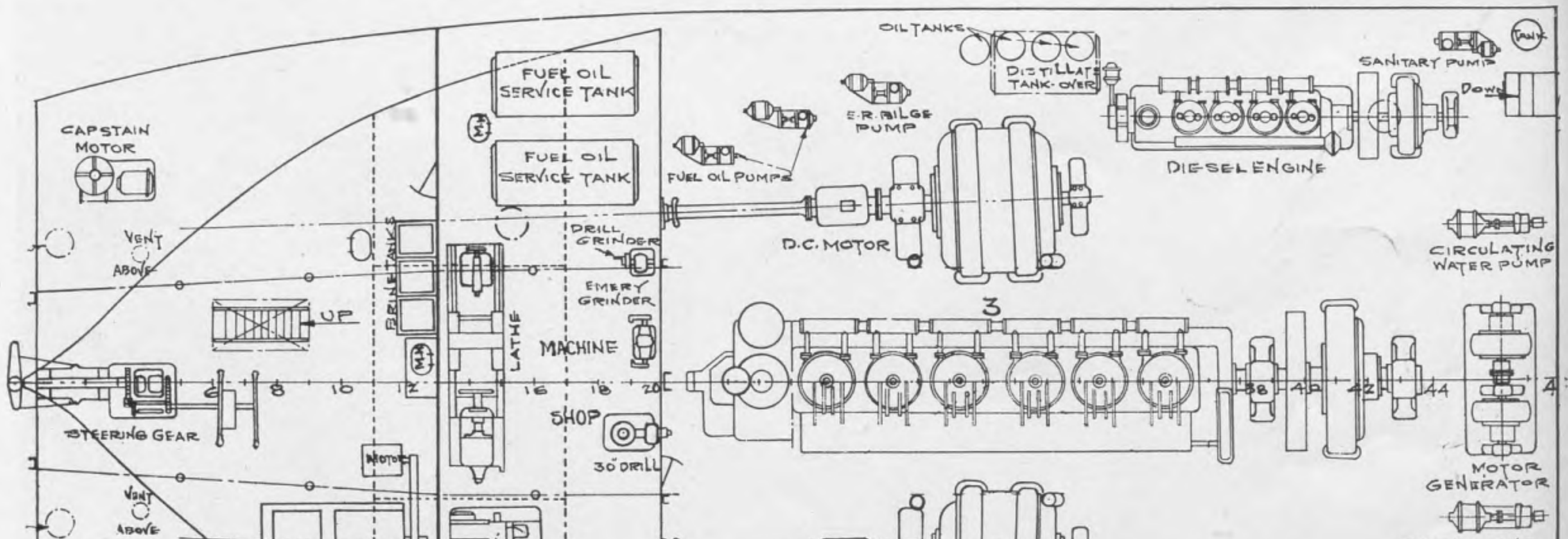
Economy of Operation—Because of the fuel economy of the Diesel engine, the operating cost of these dredges will be less than if steam drive were employed.

Freedom as to the Arrangement of the Machinery—Were the propellers and the pumps of these dredges driven by direct-connected engines of any kind, the positions of all of these machines would be definitely fixed. In designing the vessels, therefore, the designer would be compelled to start with this machinery lay-out and adapt the dredging apparatus to it as best he could. With Diesel-electric drive, however, much greater freedom is given the designer, because the engine-generator units are not fixed as to location but can be placed almost anywhere convenient.

A study of the plans of these dredges shows that advantage has been taken of this fact. There are two engine-rooms, one forward of the ladder well and containing the dredge pump, and the other aft of the well and containing the propeller motors. Only one engine-generator unit is placed in the aft engine room while the other two are placed in the forward engine room at a considerable distance from the propellers and, moreover, off center. In other words, these vessels were designed primarily as dredges, and the machinery was fitted in wherever it could most conveniently go. Therefore, even if everything else were equal, these dredges will be more efficient *as dredges* than they would be if the direct drive were used.

Interchangeability of Generators—Were each propeller and the main dredge pump of these dredges driven by its own individual engine, the breaking down of any one of the engines would badly cripple the vessel on which the accident happened. Either the dredge pump would be out of commission, or the vessel would have to propel itself awkwardly with a single screw. But with Diesel-electric drive the utmost flexibility of connections is permitted. The switching arrangements provide for seven different combinations; namely, any generator to any motor; any one of the three generators to both propeller motors; and either of two generators to the dredge motor. Consequently, the breaking down of one engine would not seriously interfere with the operation of either the dredge or the propellers, and even if two engines were down, the vessel could still be propelled without difficulty.

A special switching device has been designed to effect these various connections. This device is mounted on the main switchboard and consists of a group of contactors opened and closed by a system of cams which are operated by a handwheel. There are eight different positions for the handwheel, corresponding to the seven combina-



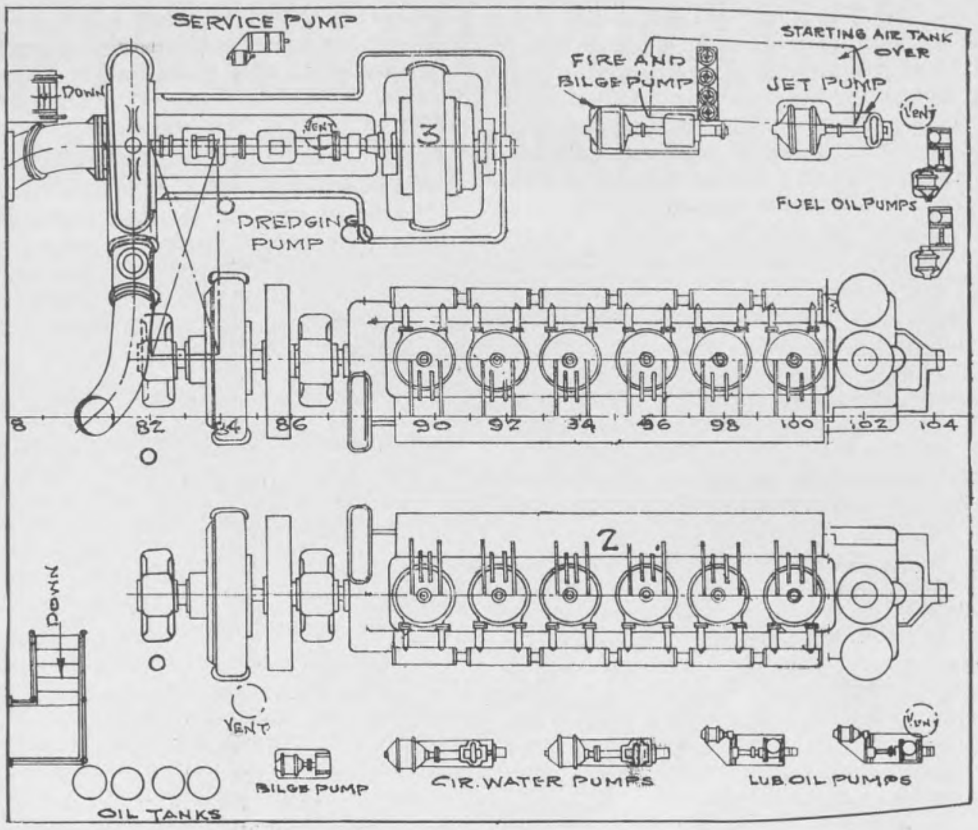
Plan of aft engine-room showing propelling machinery

tions and a point where all circuits are opened. The handwheel can be locked in each position, and cannot be moved until all circuits are open, so that heavy main-line currents are not broken by the contactors.

Ease of Manoeuvering—In accordance with standard Diesel-electric practice, all movements of the propeller motor are to be controlled by two small rheostats (one for each motor) located in the pilot house with duplicates in the engine room. The complete control of the vessel, therefore, will be in the hands of the navigating officer, which is very desirable because of the constant manoeuvering that is required of these dredges.

Among the motor-driven auxiliary machines on each dredge are 25 auxiliary pumps, 2 air-compressors, the steering gear, a windlass, 2 capstans, 2 winches, 2 hopper-door openers, the ladder hoist and the refrigerating machine. Most of the motors for these machines are to be of the ordinary open standard type, with impregnated windings and non-corrodible small parts. The winch motors and the hopper-door motor, which are to be mounted on the open deck, are to be of the cast-steel, watertight design, which has proved so successful on the M. S. WILLIAM PENN and CALIFORNIAN.

The control of almost all of these motors is to be of the automatic type; that is, the operator merely pushes buttons or turns a light master switch to start, stop and control the speed of the motor. The use of controllers of this kind insures the maximum ease and safety of operation and is in line with modern industrial practice.



Forward engine-room containing dredging machinery

Included in the electrical equipment of each dredge are to be 88 electric cabin-heaters, ranging from 1,000 to 5,000 watts each in capacity; three 5,000-watt water-heaters for each hot-water boiler, 23 electric fans and two electric ranges of 22-kilowatt capacity each, all of Westinghouse make. The auxiliaries will be supplied with current from two auxiliary Diesel-engine-driven 150-kilowatt, 250-volt generators, and also from a 150-horsepower motor-generator set, which can be supplied with power from the generator normally used to operate the dredge pump motor.

PROPOSED CONVERSION OF STANDARD OIL BARGE

Bids for converting the barge No. 95 of the Standard Oil Company of California into a Diesel-driven tanker in which will be installed the two 850 b.h.p. Pacific Werkspoor Diesel-engines purchased by the company several months ago from the Shipping Board were received December 1 and taken under consideration. Whether the conversion job actually will be undertaken, or whether the Standard Oil Company will hold its two engines in reserve for the time being, has not yet been determined.

The barge is at present arranged with ten cargo-tanks, a boiler-room forward and a pump-room aft, and the proposed plans call for converting the after portions of the cargo-tanks and the existing pump-room into engine space. In addition there are to be constructed deckhouses to be distributed amidships and aft for the use of the deck and engine-room crew respectively and for installing twin-screw 850 b.h.p. Diesel-engines with necessary auxiliaries. The converted vessel is expected to develop an approximate loaded speed of nine knots.

If converted, the tanker will have 58,000 d.w tons capacity, including fuel and stores. The present steam-plant and the auxiliaries will remain unchanged, so the pumps and deck machinery will continue to be steam-driven. The new pump-room will be just forward of the engine-room in what is now cargo-space. All the quarters on the barge will be changed, according to the proposed plans, and not more than three men will be quartered in one room. All the quarters will be above the weather deck.

THE SEARCH FOR OIL—A WORLD GAME

In the August, 1922, issue of MOTORSHIP was described a new Diesel-electric tanker under construction for the Standard Oil Co. of California and it was mentioned that this company had been one of the pioneers among the oil companies in adopting Diesel-power for its tankers. Some of us who so quickly and with such little trouble fill the fuel-tanks often do not realize that the oil-producing and marketing companies must constantly maintain a staff of experts continually exploiting new fields.

Regarding this search for oil the Standard Oil Co. of California in its current Bulletin under the caption 'A World Game' says the following:

"Only two years ago the supply of petroleum products here was insufficient to meet the demand. California's current production was not enough, and inroads were made into reserve stocks which reduced them to a point near depletion. The Pacific Coast was compelled to go eastward for its supplies, to the mid-continent field, the Gulf and to Mexico. Now it is utterly different. California's production has mounted. The diminished reserve stocks have been replenished. A flow of oil has started outward. Great tankships are carrying California oil through the Panama Canal to the Atlantic seaboard sailing right by the formerly prolific Mexican field to which we once turned in distress. California oil is going also to Great Britain, and the markets of the west coast of South America, formerly supplied from California, and then from Mexico, are again being supplied from California."

It is pointed out that the mere production of a surplus, with consequent lower prices, is not wholly responsible for the condition. "A vital factor is the existence of a great field of tankships," says the company. "Tankers of increasing capacity were built in great numbers during the war and since. Owing to the existence of these tankers, petroleum may be moved in huge volume from one side of the world to the other. Hence, the shifting scenes of today.

"Although California's supply now exceeds local demand, this may be no more than a momentary phase, as such things go, and the quest for new oil goes on without cessation. This company, for example, is searching in the far places of the world for new oil fields—in the Philippines, Alaska, Ecuador, Colombia and the Argentine, as well as in Montana and Texas. It is indeed a world game, and costly, but well worth the cost.

"The company points out that its Alaskan expedition shows the magnitude as well as the difficulties and hardships of wildcatting. In the Philippines the company has been drilling for nearly two years—so far no oil. The cost of that expedition is more than $750,000, which again illustrates the magnitude of this business. But if oil is finally discovered the money will come back, and with something far more highly prized by the true oil man—the accomplishment of the industry's greatest possible achievement, the production of crude oil where none was produced before."

(Continued from page 18)

It will be seen that results are very close.

In using the above approximate formula one must remember, however, that it is on the high side on account of the volumetric efficiency being taken at 100%. As actually the volume drawn into the cylinder at each stroke is less than the capacity of the cylinder, a correction may be made with advantage. It will be found that the volumetric efficiency is about 90%.

HEAT AVAILABLE IN EXHAUST GASES

The data as enumerated in the previous statements indicate the potential heat energy, and the question arises as to how much heat can be usefully employed. The radiation losses are, of course, considerable, although the actual percentage depends on the method and extent of utilizing the available heat.

The drop in pressure, the frictional losses and the ineffective heating surface are responsible for a loss of heat, which is unavoidable. In a certain installation exhaust temperatures were measured at various points, as recorded in Table No. IX. The exhaust pipe was water-cooled and in the length under observation there was only one bend. The outlet cooling water temperature was about 120° F.

TABLE NO. IX.

Distance from Exhaust Valve	Diameter of Exhaust Pipe	Temperature °Fahr.
9″	6″	685
6′0″	8″	668
26′0″	8″	480
33′0″	8″	356

Taking the average figures for the factors which make up the total potential heat in exhaust gases, we can now establish the total heat in exhaust gases per horse-power as follows:

$$\text{Total heat} = 0.108 \times 0.028 \times 0.250 \times 1200$$
$$= 0.91 \text{ HP. B.Th.U. per sec.}$$
$$= 3{,}275 \text{ HP. B.Th.U. per hr.}$$

Allowing for volumetric efficiency (as we have assumed 100% in our approximation) radiation and a reasonable temperature of the exhaust gases on leaving the waste heat boiler, we find that:

Total available heat = 1650 B.Th.U. per hour per horse-power.

If we assume the exhaust gases to be utilized for steam raising purposes, then with an exhaust boiler efficiency of 60% we get 990 B.Th.U. available heat. The boiler pressure may conveniently be fixed at 100 lbs., hence

Steam available = 0.85 lbs. per H.P. hour
or
1.0 lb. per H.P. hour from and at 212° F.

With a 3,000 H.P installation, therefore, we may expect an output of 90 to 135 H. P. for auxiliary purposes, whilst at sea (30 to 25 lbs. of steam per I.H.P. hour) steering gear, circulating-pumps, ballast-pump, oil transfer pump, feed donkey and dynamo can all be steam-driven sets.

In port the cargo winches will necessitate the exhaust-boiler being arranged for oil-firing, and in all probability would demand a larger evaporation than when at sea. Hence in most cases the boiler rating will have to be designed for port conditions and at sea the boiler efficiency would be somewhat lower than 60%, as suggested above.

AVAILABLE HEAT IN JACKET-COOLING WATER

In the above calculations no account has been taken of the available heat in the cooling water. If the cooling water is taken from the sea and pumped overboard again, then sufficient fresh water must be carried for the exhaust-boiler together with the necessary cooling plant and exhaust returns from the various auxiliaries as far as possible, unless an evaporator is fitted.

If fresh water is used for cooling wate then the boiler-feed can be taken direct fro the engine jackets. There is an addition advantage when using fresh water f jacket cooling, because the circulatin water outlet temperature can be raised 150° to 170° F. as against 110° F. in t case of sea water. There would thus be additional gain of useful heat with the co respondingly larger amount of steam p H.P. hour.

As is well known by now, the Still com bination steam and internal-combusti engine uses this system to great advanta with a resultant gain to the therm efficiency of the main engines. Some 18 of useful heat is recovered, raising the th mal efficiency of the Still engine from 33 to 39%.

It is hoped that in the foregoing certa data have been submitted which may pro interesting to those engineers who ha considered the question of utilizing so of the heat which at present is lost for time. As in most problems of this natu one cannot be dogmatic, but must confi oneself to recording the various aspects the problem in a general way.

The question of total net effect depen on the extent to which the combined he of the circulating water and exhaust ga can be utilized. It will be found that und certain conditions only the exhaust he may be used to advantage. There ag one must investigate the percentage of he which will be extracted from the exha gases by the cooling water before the ga reach the boilers.

It is hoped that in a future reference this subject, some actual designs of exha boilers will be discussed and to what tent they have justified their installati on board of motorships.

Another Successful Wooden Motorship

Recent Record of the "Santa Flavia"

In 1918 and under war conditions two wooden motorships were built for W. R. Grace & Co. of New York, which they operated in South American trade. One of these vessels was the SANTA FLAVIA, a vessel of 2,000 tons gross, constructed at the Aberdeen Shipbuilding Company's yard at Hoquiam, Wash. In February of last year she was purchased by the International Packing Co. of Seattle, Wash., S. Chase, Jr., President, who converted the ship into a floating cannery. Her owners sent her to Alaska last spring, packed with salmon, and she arrived back in the fall, covering a total of 6,000 nautical-miles for the round trip. It is to be noted that in addition to fuel for the round voyage she carried 32,000 cases of salmon. Furthermore, when going to Alaska in spring she carried twelve fishing boats on deck and towed two 65′ seine boats, each powered with a 50 h.p. distillate engine. There was no trouble with the twin oil-engines, except for a few bearings that burned out, her engine-room crew having never previously operated oil-engines of the make installed.

In a conversation with the Editor of MOTORSHIP S. Chase, Jr., stated that there is no regular transportation on this route, so accident and failure of her engines to operate would be very serious; but the running of this vessel has given them complete confidence in oil-engine power. Compared with gasoline engines, the reduction and consumption was so great that it is almost incomparable. The fuel burned by the vessel cost 5¼ cents per gallon.

Wooden motorship "Santa Flavia"

The SANTA FLAVIA has the following dimensions:

Length ....235′
Breadth ....43′
Depth ....19′ 3″
Power...........640 shaft h.p.

She is propelled by twin Bolinder surface ignition oil-engines of the two-cycle type each of 320 shaft h.p. at 225 r.p They are four-cylinder engines of the dire reversible type, 16½″ bore by $18\frac{15}{16}$″ stro Although a wooden ship, there has been trouble whatever with the hull, illustrati that up to a certain size wooden vess when soundly built are practical prop tions.

ADMIRAL GOODWIN AND THE OIL-ENGI

In his presidential address before t Institute of Marine Engineers, Inc. (Lo don), Engineer Vice-Admiral Sir Geo. Goodwin, K.C.B., Lld., said: "Oil engi for propelling and auxiliary purposes w compel profound consideration for man long day, and in the near future discussio may take in large part a different fo Before development can proceed much fu ther we shall have to get farther back in the cause of things, and endeavor to asc tain the nature of the physical and chemi changes which occur during the seve stages of the cycle, the conditions affecti penetration and dispersion of the fu during the period of combustion, the cau and effects of detonation, the nature of t combustion of the oil itself, and the chang of temperature in the gases throughout t cycle. Much more than is known at pres must be elucidated respecting temperat changes in the materials exposed to he and the manner in which those materi behave and change while undergoing ra fluctuations of temperature."

MOTORSHIP "FORDONIAN" MAKES RECORD ON GREAT LAKES

Carrying 2,900 tons of cargo, the Diesel-electric-driven motorship FORDONIAN made the record haul of grain through the Welland Canal this year. The trip was from Milwaukee to Montreal and the rate paid, free on ship, was 14 cents per bushel or aggregating about $16,240 for eight days less discharge. The previous largest cargo taken through the Welland Canal was also made by a motorship, namely the TOILER which loaded 2,556 tons of wheat in the year 1919.

Incidentally, it should be noted that the loaded draft of the FORDONIAN was limited to 14½′ through canals. The FORDONIAN has made steady trips from Buffalo to Montreal at 10 cents per bushel, capacity cargoes free on. At the time of writing she is en route to Quebec where they cargoed at 12 cents loaded at Buffalo. During the winter months, she will be operated on the Atlantic Ocean. On several occasions she has carried newsprint to Detroit from Three Rivers and Quebec, at the rate of $4 per net ton and has averaged 1,367 tons of cargo. Also, coal was taken from Three Rivers at the $3 rate sold at port. Coal is free on and free off, fast docks.

Writing to us regarding the performance of this vessel, A. C. Jackson, freight broker, 1150 West Ferry Ave., Detroit, Mich., states he would like to have the placing of cargoes on four more motorships like the FORDONIAN. He did not previously have an idea that Diesel-driven vessels would haul so much cargo on such shallow draft, and that there is lots of business on the Lakes for this class of ship. He will be glad to hear from shipowners.

SINGLE-SCREW 3,000 B.H.P. CAMMELLAIRD-FULLAGAR MOTORSHIP ORDERED

Palmers Shipbuilding & Iron Co. of Jarrow-on-Tyne, England, have received an order for a motor-tanker of 10,000 tons to be driven by a 3,000 brake h.p. Cammellaird-Fullagar engine of 6 cylinders of 23″ diameter by 36″ stroke. This engine will operate at 86 r.p.m. and will be the largest engine of this type yet built, except the 5,000 brake h.p. set being built for experimental purposes. Scavenging-pumps will be arranged at the top of each crosshead and there will be two 3-stage air-compressors driven from one crank forward. Circulating and bilge-pumps will be driven by the engine.

DIESEL-DRIVEN FERRY FOR CANADIAN PACIFIC RAILWAY

British Columbia shipbuilders have been invited by the Canadian-Pacific Railway to submit plans for a Diesel-engined ferry boat to run between Bellingham, Wash., and Sydney, Vancouver Island, carrying passengers and automobiles. She will be a boat of large capacity, having accommodation for 250 passengers and 50 cars. A speed of 14 knots is required. It is stated that the Wallace Shipyard of No. Vancouver and Yarrows Shipyard of Esquimalt are figuring on this vessel, but up to date the plans have not been accepted.

As is published elsewhere, bids have also been invited on a 500 h.p. Diesel-driven vessel by the Sydney-Anacortes Ferry Company.

U. S. SHIPPING BOARD'S DIESEL ENGINES

As we write, all the Diesel marine-engines built for the U. S. Shipping Board Emergency Fleet Corp. have been disposed of with the exception of two 750 shaft h.p. McIntosh & Seymour left-handed engines now in storage at Hog Island. The other engines were sold as follows:

Shaft H.P.			
900		13	War Department, Washington, D. C.
900		3	Munson Line, 67 Wall St., New York City.
900		2	McIntosh & Seymour as agents.
825		2	Standard Oil Co. of California, San Francisco, Cal.
825		3	Benson Lumber Co., San Diego, Cal.
825		1	Federal Light & Traction Co., New York City.
825		4	Moore S. B. Corp., San Francisco, Cal.
750		2	Federal Shipbuilding Corp., Kearny, N. J.
750		1	Universal Machine Co., Bowling Green, Ohio.
750		1	National Oil Co., New York City.
750		2	Vacuum Oil Co., New York City.
320	(Bolinder)	2	Cary-Davis Towing Co., Seattle, Wash.

The 900 and 750 shaft h. p. Diesel engines were manufactured by McIntosh & Seymour of Auburn, N. Y., while the 825 shaft h.p. Diesel engines were manufactured by the Pacific Diesel Engine Co., of Oakland, Calif.

TWO MOTOR FERRY BOATS FOR AMSTERDAM

During November two motor-ferry boats built for the Municipality of Amsterdam were launched. One is the YOEER 9, built by N. V. Sheepsbouwerf "De Merwede" v/h Van Vliet & Co., Neder-Hardinxveld, while the other, name not made public, was built by N. V. Scheepswerf Machinefabriek Wed. J. L. Ceuvel, Amsterdam. These vessels are 67′ length o.a., 16′ breadth and 6½′ draft, and are each equipped with a 70 h.p. Kromhout oil-engine. 120 passengers are carried on each boat.

NEW FULLAGAR-ENGINED JAPANESE MOTORSHIP

In a large motorship now under construction in Japan, twin Cammellaird-Fullagar opposed-piston Diesel engines of 2,500 shaft h.p. each will be installed. They are six-cylinder sets which have been constructed under license by John Brown & Co., of Clydebank, Scotland. Four cylinders of this unit have already been run for six and twelve hours' continuous trials in the shops with pleasing results. The advertisement of the Fullagar engine in the May, 1922 issue of MOTORSHIP caused considerable interest in Japan as well as in this county and requests for copies continue to reach us.

CHANGES IN WORTHINGTON PUMP ORGANIZATION

E. T. Fishwick, formerly sales manager, has been made vice-president in charge of sales to succeed F. H. Jones, vice-president, resigned.

J. E. Sague, V. P., resigned, succeeded by William Goodman, formerly assistant to the vice-president.

James C. Barnaby, formerly plant engineer of Staten Island Shipbuilding Co., now in charge of certain engineering work in Diesel oil-engine division of Worthington Pump & Machinery Corporation.

RECENT PERFORMANCE OF WOODEN MOTORSHIP "DONNA LANE"

According to Chief Engineer A. O. Hinch, the American wooden motorship DONNA LANE has run 27,000 nautical-miles during 1922 up to the end of November. The repairs on the Diesel-engine machinery amounted to less than $10.00. For the last 12,000 miles there was only one 15-minute stop. On one voyage from Manila to San Francisco, a distance of 6,535 nautical-miles was covered in 35 days, 6 hours, 23 minutes without any stop whatsoever. In fact, the exhaust-valves were changed without stopping the engines. The DONNA LANE is propelled by two McIntosh & Seymour Diesel engines of 500 shaft h.p. each.

PRESIDENT McFARLAND ON MOTORSHIPS

In his annual address on November 8th Capt. W. M. McFarland, President of the Society of Naval Architects and Marine Engineers, referred to Diesel propulsion of ships in the following words:

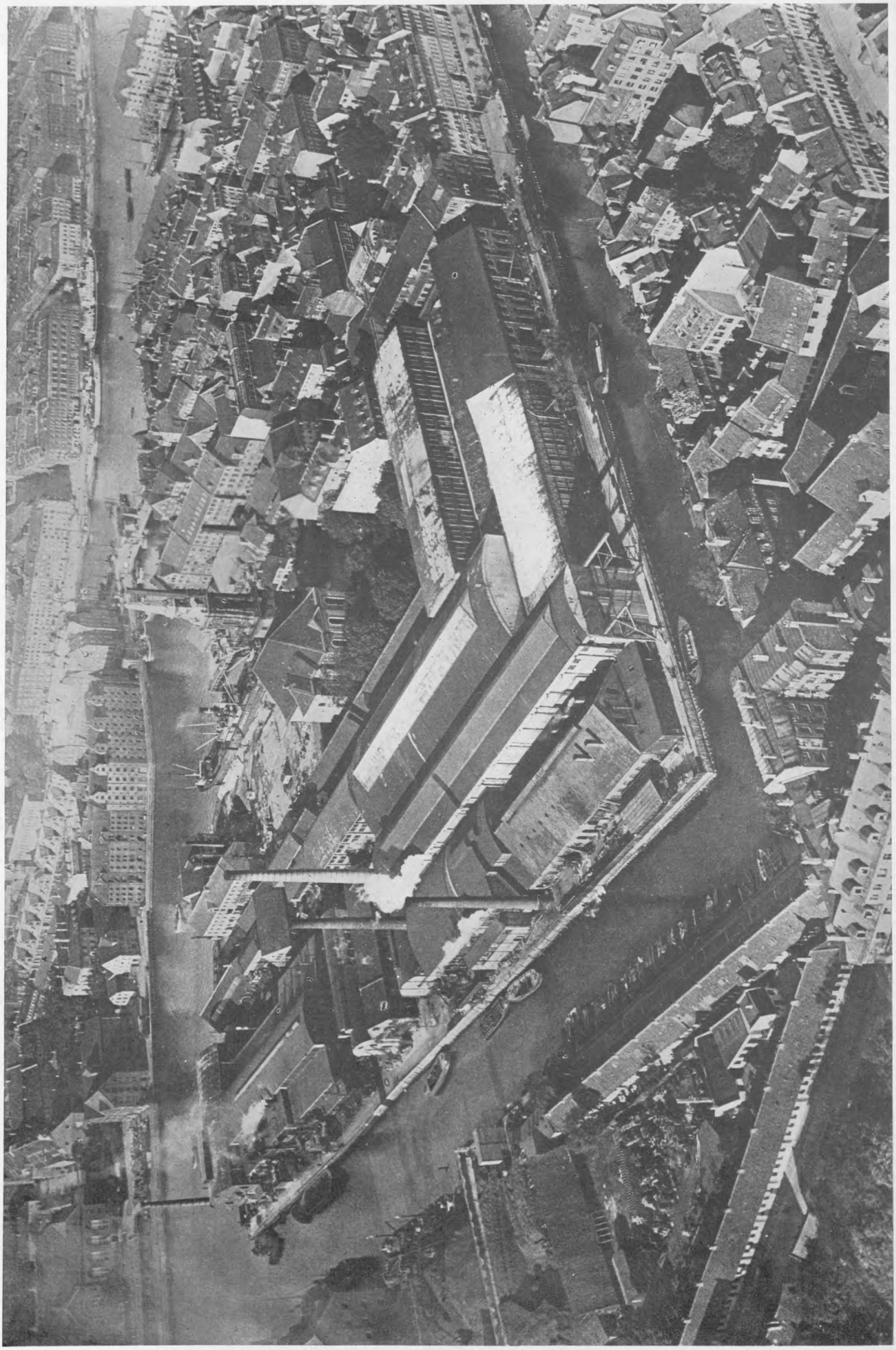
"The very high thermal economy of the Diesel-engine has brought it into very serious consideration in these days of the necessity to save at every point. A recent statement gives the number of motor ships afloat at about 1,450, with about 180 under construction. Nearly all of these are of moderate or small power, although the hulls are often of large tonnage. The growth in recent years has been from 290 afloat in 1914 to the number above. It can hardly be said that any one design has thus far been accepted as the standard, and many able designers are working along various lines in the effort to bring down weights and initial cost. . . . Another form of the electric drive where Diesel-engines are used as the prime mover instead of steam engines is being tried out in some vessels of moderate size and power. The limitation of the Diesel-engine to small powers per cylinder has, of course, thus far ruled it out of any installations of very powerful machinery."

ANOTHER WARSHIP TO BE CONVERTED

Some time ago we published illustrations and descriptions of the motorships ODIN and AEGIR, owned by the Adolph Bernstein Co., of Hamburg, which were converted into Diesel-driven cargo ships from German warships. We understand that during one and a half years' regular service these vessels have shown excellent qualities, so the Bernstein Co. has given an order to the Deutsche Werke, of Kiel, to convert a third vessel of this kind into a cargo-carrying motorship. The name of this craft is the FRITHJOF.

LARGE DIESEL YACHT FOR EGYPTIAN YACHTSMAN

Ramage & Ferguson of Leith, Scotland, have received an order from an Egyptian yachtsman for the construction of a 200′ motor yacht to be equipped with two 850 h.p. Sulzer Diesel-engines of the four-cylinder port-scavenging type. This new craft will be larger than any oil-engine driven motor-yacht yet constructed and will be an attractive ship. The auxiliaries will be steam driven. Scavenging-pumps and air compressors will be direct driven and it is estimated that the fuel-consumption will not exceed 8 tons per day.



General view of the Diesel Engine Works of Burmeister & Wain, Copenhagen, Denmark

Pioneers of Large Motorships

Plant of the Notable Danish Diesel Engine and Shipbuilding Firm of Burmeister & Wain

THEIR development of the Diesel-engined vessel has made Burmeister & Wain one of the best known shipbuilding firms in the world, and today more large freighters are equipped with their type motor than any other design, totaling 101 craft of 841,551 aggregate deadweight tons and 305,330 indicated horse power. At today's market for tonnage this fleet represents a value exceeding $60,000,000. Many of their ships and engines, of course, were constructed by their licensees, such as the Götaverken (Sweden); William Cramp & Sons (United States); Harland & Wolff (Scotland); Barclay-Curle (Scotland); Deutsche Werft (Germany), and the Akers shipyard (Norway), but about 44 were built and engined by Burmeister & Wain themselves, who also supplied the engines for another half-dozen ships, including the WILLIAM PENN, turned out at yards without Diesel licenses.

Burmeister & Wain built the first merchant motorship of over 5,000 tons deadweight. In fact, their initial attempt consisted of two vessels of 7,500 tons in 1911, while a third motorship was simultaneously laid down under their supervision at Barclay-Curle's, Glasgow. Burmeister & Wain are also credited with having first adopted the Diesel electric deck and engine-room auxiliaries, now almost standard practice for motorships of all nations.

To a partial extent their success is due to the confidence shown in them and in the oil engine by the East Asiatic Company, particularly, in the early days of the marine Diesel engine development when this great shipping and trading concern boldly ordered three 7,500 ton ships in one contract. At that time no motorship of over 2,000 tons was afloat outside of those on the inland waterways of Russia, which vessels were practically unknown outside of that country, having been developed mostly by the Russian oil companies for their own transportation. In the British Isles Viscount Pirrie has wholeheartedly developed the Burmeister & Wain design by means of his great Harland & Wolff shipyards, and through his numerous associated ship owning companies.

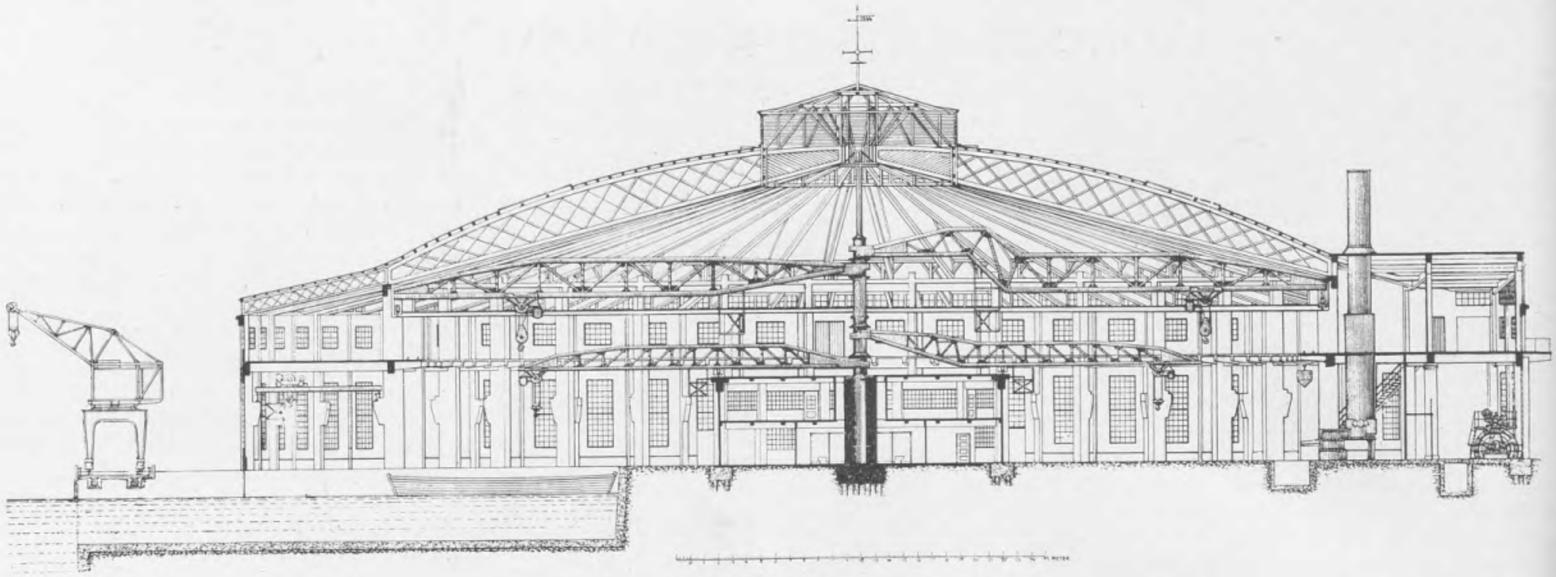
Director H. H. Blache

Prior to having taken up building Diesel engines, Burmeister & Wain were experienced in the construction of marine steam engines from 1846, and had been building Diesels for stationary purposes since 1898, when they first secured one of the original rights to build under Dr. Rudolf Diesels' patents. A great number of these stationary engines were sold in Denmark, then the market expanded, and consequently their work-shops were re-equipped with special tools for building Diesel engines in quantity production.

The Burmeister & Wain plant at Copenhagen is divided into three sections, the shipyard being situated just at the entrance of the old harbor and the new free port, the engine works in the old harbor and the new foundry. But heavy engine parts are easily transferred in lighters to the shipyard or engine works.

We are able to give an aeroplane view of the complete engine plant which, it will be noticed, is in the crowded part of the city, being surrounded by water on three sides and by business buildings, churches, etc., on the south side. There is a forging shop equipped with two hydraulic presses for the forging of heavy crankshafts, etc. One of

Diesel-engine erecting shop at the Burmeister & Wain Works in Copenhagen



Drawings of the Burmeister & Wain cast-iron foundry

these is of 2,000 tons power and the other of 1,200. There is a Siemans Martin furnace with a capacity of 10,000 tons steel per annum, partly in steel castings and partially in ingots up to 58 tons each. There is a coppersmith's shop, brass foundry, pattern shop, drawing office, etc. One of the principal machine-tools in the Diesel engine shop is their remarkable crankshaft milling machine, the rights for which have been acquired in the United States by the Midvale Steel Co. This machine enables the crankshaft to be roughly machined in a very short time, hence reducing the cost. It was described and illustrated in MOTORSHIP about two years ago. It has a turnplate to which the lower end of the crankshaft is fixed in a vertical position. The only limit of the size of the shaft to be machined is the depth of the pit.

Another interesting machine tool is a super-milling machine which is believed to be the largest in the world, and an illustration accompanies this article. It is capable of handling the largest castings made. It comprises two large towers and a 60-foot bedplate, and the power necessary to drive the tower spindles consists of two 50 h.p. electric motors—one for each tower. The towers themselves are moved longitudinally by 20 h.p. electric motors—one for each tower. The spindle carriage on each tower is raised or lowered by means of an 18 h.p. motor. By the provision of the great cutting length, engine parts can be machined at one end, while additional work is proceeding simultaneously at the other end. Moreover, with the great distance between the towers, it is possible to machine the largest Diesel-engine castings at two opposite surfaces simultaneously, thereby ensuring parallel work. It is also possible to machine surfaces at any desired angle. To give a comprehensive idea of the size of this machine, we will quote its general dimensions:

Weight	500 tons	
Cutting length	10 m.	(32- 8 ft.)
Cutting height	4 m.	(13-12 ft.)
Distance between cutters on the towers	4 m.	(13-12 ft.)
Diameter of spindle	325 mm.	(12- 8 in.)
Diameter of cutter up to	600 mm.	(23- 6 in.)

The main erecting shop is served by three overhead electric traveling cranes, two of which have a capacity of 50 tons and the third of 30 tons. The principle of line production has been adopted, and the situation of the several other shops in relation to this erecting and testing shop is such that each item of machinery, as it passes through the various stages of manufacture, gradually and automatically progresses towards the erecting shop.

The main erecting shop is 292 feet 2 inches long by 91 feet breadth and 39 feet 4 inches height from the floor to the crane hook. The largest Diesel engines now being built at the present time are 2-8 cylinder sets of 3,300 i.h.p. An interesting development now being carried on is a remarkable four-cycle engine, at present being built in a single cylinder of about 1,000 h.p. We hope to say more about this engine when further progress has been made.

Both the crankshaft milling machine and the super-milling and boring machine were designed by one of the Directors, namely, Mr. Overgaard, and were built by Burmeister & Wain themselves, which is yet a further demonstration of the firm's enterprise. It has been estimated, with reference to the first of these machines described,

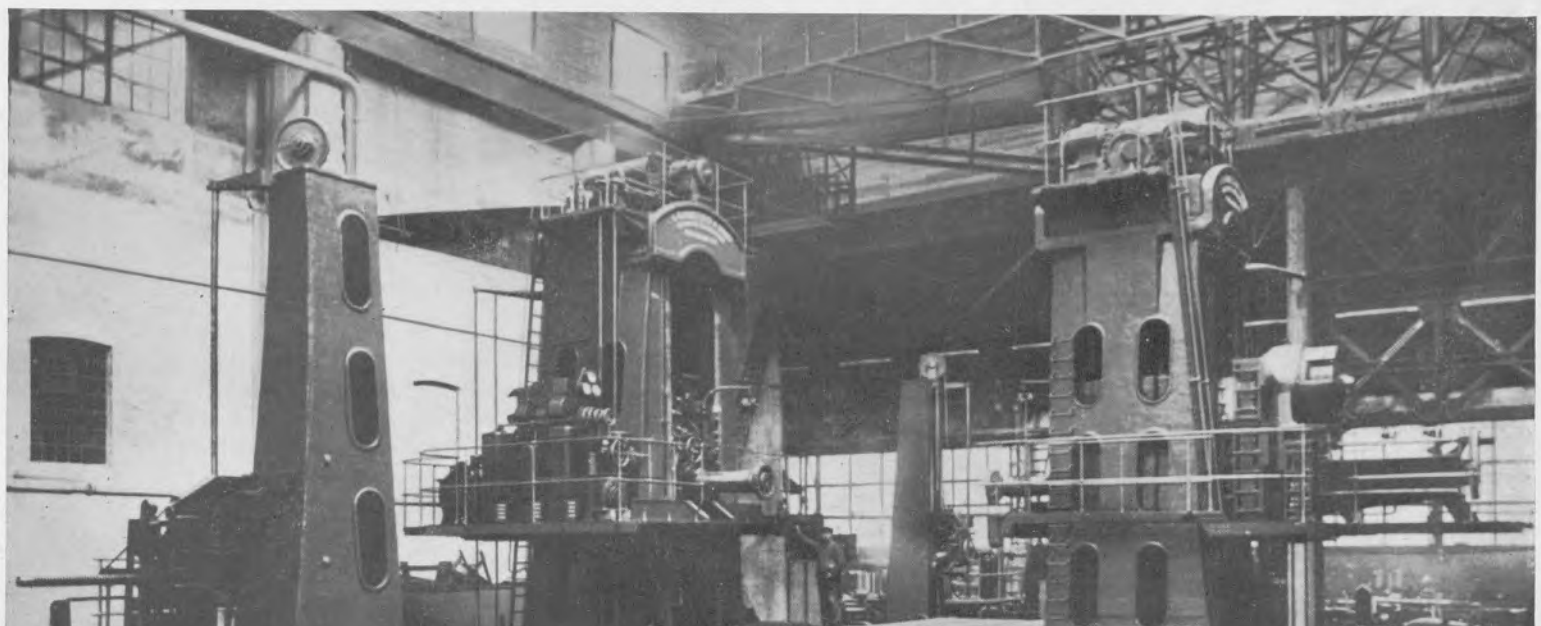
Exterior view of the unique cast-iron foundry at the Burmeister & Wain plant

View of the Diesel engine machining shop at the Burmeister & Wain plant

that, assuming 300 working days per year and 8 working hours per day, its annual capacity for machining heavy engine parts is about 12 twin-screw installations, each installation being of about 4,500 h.p.

For furnishing power to the engine works there are several B. & W. land-type Diesel engines installed in a power-house of elaborate design and decoration, as will be seen from the illustration. There are two cast-iron foundries, the old one and a new one of an unusual circular form, equipped with all the latest and most modern cupolas and moulding equipment.

From the outset Burmeister & Wain have held to the construction of 4-cycle engines, believing that for many technical reasons Diesel engines of 2-cycle type are more complicated and less suitable for ship propulsion; also that the external dimensions and weight for the same h.p. at the same number of revolutions will be greater than for those of corresponding 4-cycle engines. It is also their belief that strict adherence

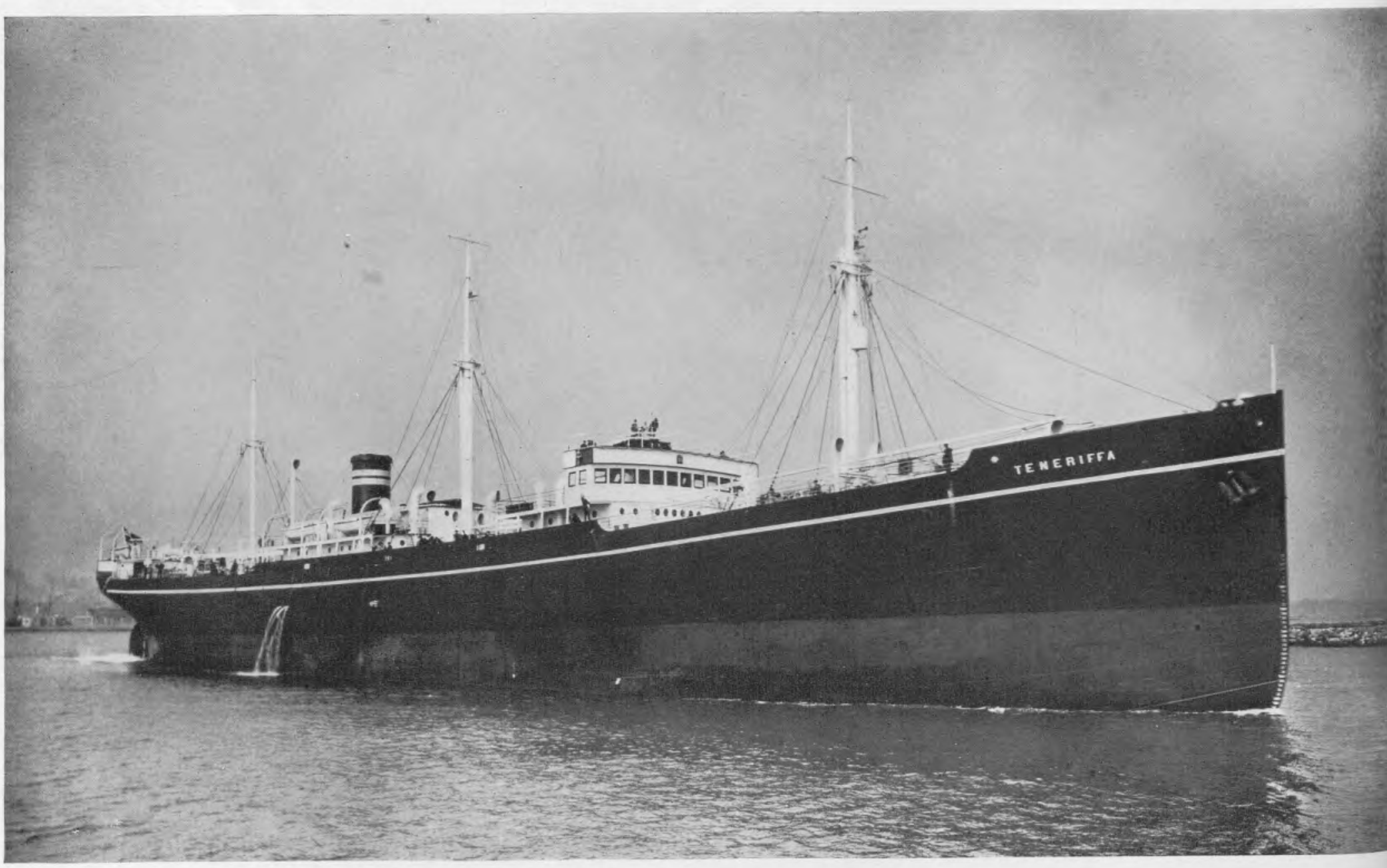


View of a Mammoth universal tool built by Burmeister & Wain, especially for machining heavy parts of Diesel engines. The angle at which the photograph was taken does not give an idea of the true length of the bed-plate

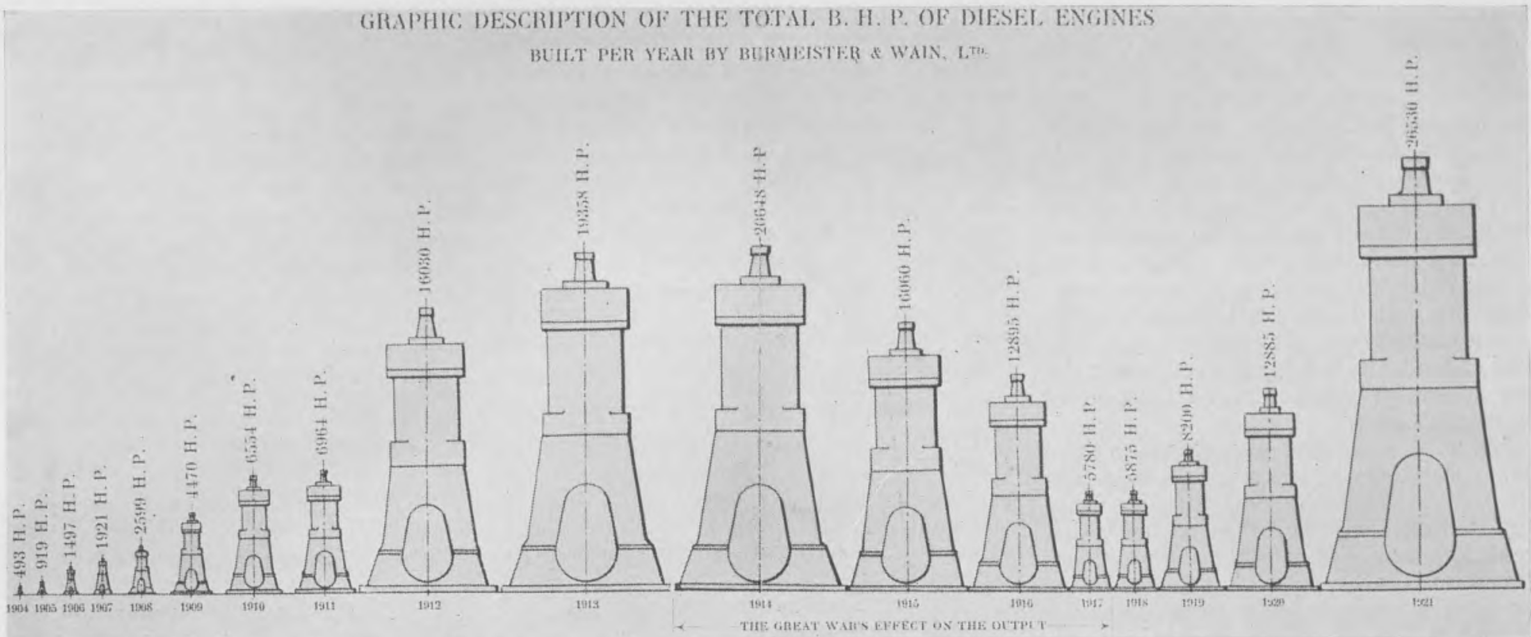
The "Afrika," one of the first Burmeister & Wain motorships, passing through the Panama Canal

to this policy combined with conservative design and good workmanship have been responsible for the success of the B. & W. engined 100 vessels in service.

The shipyard at the entrance of the old harbor is equipped with five building berths, of which two are for 600-foot ships and 3 for large vessels up to 445 feet in length. Furthermore, there are two fitting-out piers with all modern equipment, one hammer-head crane of 100 tons lifting capacity and two 20-ton cranes, the latter handling the lighter work. For small vessels there are three slipways. There is one graving dock of 475 feet length and one floating dock with a capacity of 11,500 tons. Considerable expansion is now being planned by the company, including the extension of their present floating dock and the construction of a new one. The plans have already been approved by the War and Marine Minis-



The "Teneriffa" is typical of the latest product of Burmeister & Wain



tries. The present dock has a length of 148 meters; this is being increased to 172 meters long and 13,600 tons capacity. The new dock will have a length of 130 meters and 7,500 tons lifting capacity. When this work is completed Burmeister & Wain will be in a position to take care of the repair of the largest ships in the merchant marines of the Scandinavian countries.

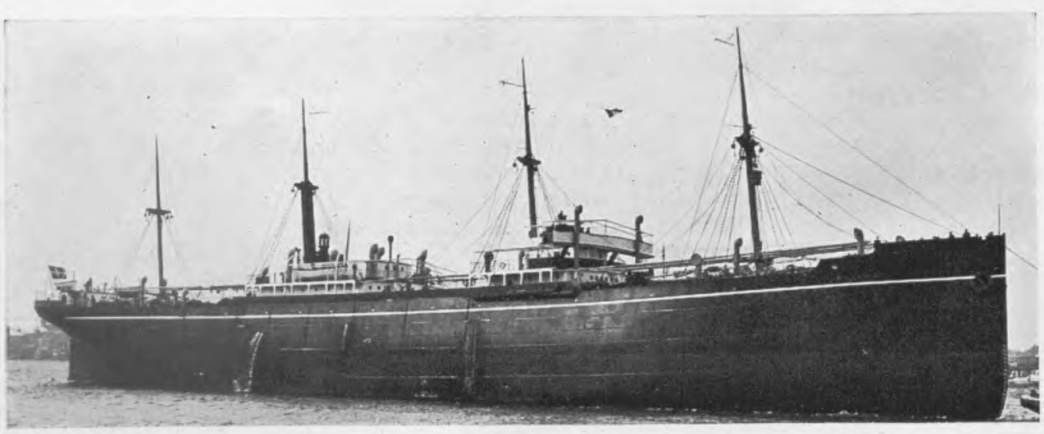
BURMEISTER & WAIN ENGINED DIESEL MOTORSHIPS

In Actual Service

NOVEMBER 1st 1922.

Name of Ship	*Machinery Installed*	*I.H.P.*	*Gross Tons*
Selandia	1912	2500	4950
Jutlandia	"	2500	4950
Fratelli Bandiera	"	2500	4956
Suecia	"	2000	3730
Pedro Christophersen	1913	2000	4910
Siam	"	3000	6636
Annam	"	3000	6636
California	"	2600	4611
Kronprins Gustaf Adolf	1914	2000	4944
Fionia	"	4000	5219
Kranprinsesan Margareta	"	2000	3739
Makka (Stranded-Lost)	"	3100	5234
Tonogking	"	3100	6645
Pacific	"	2000	3731
Brazil	"	1500	3374
Songdal	"	1700	3466
Songvand	"	1700	3494
Mississippi	"	3200	4738
Panama	1915	3100	6650
San Francisco	"	2000	3707
Australien	"	3100	6650
Columbia (Torpedoed)	"	3100	5264
Chile	"	3100	6913
Songvaar	"	1700	3453
Kangaroo	"	2250	4433
Falstria	"	2250	4344
Glengyle	"	3000	6225
Oregon	1916	2800	4774
Peru	"	3100	6919
Bayard	"	1500	4111
George Washington	"	3100	7093
Glenartney (Torpedoed)	"	3350	7263
Glenamoy	"	3350	7269
Valparaiso	1917	2600	3762
Bonheur (Sunk By Mine)	"	3100	7086
Glenavy	"	3000	5075
Lima	1918	2600	3764
Borgland	"	2000	4894
Aba	"	6600	7938
Bullaren	"	4000	5722
Tisnaren	"	4000	5744
Asia	1919	3100	7014
Glenade	"	3200	6802
Glenariffe	"	3200	6795
Balboa	"	3100	5554
Stureholm	"	2600	4575
Afrika	1920	4500	8597
Theodore Roosevelt	"	3100	7116
Glentara	"	3200	6754
Glenluce	"	3200	6755
Glenogle	"	6000	9513
Glenapp	"	6000	9503
La Paz	"	3200	6548
Dorsetshire	"	4500	7445
Buenos Aires	"	3100	5614
Elmaren (Stranded-Lost)	"	4000	5783
Canada	"	3100	5527
Indien	"	3100	5702
Fritsoe	"	640	667
Formosa	1921	3100	7006
Malaya	"	4500	8654
Somersetshire	"	4500	7456
Frltiof	"	1250	672
William Penn	"	4500	7615
Leise Mærsk	"	1500	3015
Cometa	"	2600	3794
Java	"	4500	8681
Kedoe	"	2600	3750
Arator	"	2100	5042
Polarhavet	"	2800	4104
Balzac	"	1000	962
Louisiana	"	2800	6513
Strassa	"	2600	5650
Sulina	"	1600	2978
Hemland	"	2800	5677
America	"	2100	4917
Lobos	"	3200	6479
Leighton	"	3200	7300
Losada	"	3200	6520
Lockkatrine	"	6000	9460
Linnell	"	3200	7300
s/v Kobenhavn	"	640	3901
Laponia	1922	2600	5650
Dinteldijk	"	6000	9460
Julius Schindler	"	1550	3700
Glengarry	"	6000	9460
Canton	"	4000	6600
Glenbeg	"	6000	9460
Lassell	"	4000	7400
Teneriffa	"	3100	7072
Californian	"	1000	945
Batavia	"	4500	7899
Oljaren	"	2600	4319
Ossag	"	1550	2330
Bintang	"	1400	2779
Missourian	"	4500	7899
Erland	"	1550	2502
Isis	"	3100	5000
Thalatta	"	3100	7100
Lulea	"	2600	5630
Tennessee	"	3100	7124
Trolleholm	"	2100	5084
Tiradentes	"	3100	5800
Adda	"	6400	7800
Osiris	"	3100	5000
Arizona	"	2800	4775

Total Tonnage—568,884 Gross
Total I.H.P.—305,330.
Total Number of Ships—101.



One of the many Burmeister & Wain Motorships

CONVERSION OF STEAMER "FRANK LYNCH"

The contract for converting the steamer FRANK LYNCH, formerly the Shipping Board vessel LAKE SUNAPEE into a motorship for carrying lumber on the Pacific Coast, was awarded December 4 to the Union Construction Company of Oakland, California, for $65,974. Forty-two working days were allowed for the job, which must be done by January 31, 1923. This craft is 262 feet in length over all, 43½ feet in beam, 21 feet molded depth, net tonnage 1197½. gross tonnage 2009. It is expected that a speed of ten knots will be attained, about the same as that of steam lumber-schooners on the Pacific Coast.

This will be the first steel Diesel-engined lumber carrier on the Pacific Coast and will be used by the Benson Lumber Company of San Diego and Oregon, of which Frank Lynch is president. Captain William J. Gray of San Francisco handled the contracts. The engine to be used is one of the 850 b.h.p. Pacific-Werkspoor Diesel-engines purchased by Mr. Lynch from the Shipping Board at its Liberty warehouse in Alameda several months ago. It will be installed amidships in the existing engine-room. Present plans call for the retention of one of the two Scotch boilers, which will be heated by exhaust-gases from the Diesel-engines, thus furnishing steam for driving the auxiliaries. The boilers are 14′-6″ in diameter and 11′ long.

As the Werkspoor engine is somewhat longer than the steam engine, it will extend farther forward and bedding will be added and a screen-bulkhead removed. The aft end of the Diesel-engine will be situated at the same point as the corresponding point of the steam engine. The FRANK LYNCH already has double bottoms and some welding and caulking will put them in condition to carry fuel sufficient for 100 days, according to Captain Gray. The lumber capacity will be 1,659,000 feet. The economy in operation of the FRANK LYNCH as a motorship, Captain Gray states, is at the present price of oil about $77 a day, representing the difference between 105 barrels daily consumption for steam and 28 for Diesel drive, plus a saving of three members of the crew.

E. F. CLARK HEADS WESTINGHOUSE, NEW YORK MARINE DEPARTMENT

E. F. Clark, formerly of Philadelphia, has been placed in charge of the Marine Sales Department of the Westinghouse Electric & Mfg. Co. at New York.

Before receiving his present appointment, Mr. Clark was located in the Philadelphia office of the Westinghouse Company, where he was engaged in marine sales work in the Philadelphia, Baltimore, and Norfolk districts and handled the company's relations with the U. S. Shipping Board. He entered the company's employ as an apprentice, and in time became Manager of the Condenser Division. He enlisted during the war and served as Corporal of infantry. On his discharge from the army, he was appointed Assistant District Engineer of the Westinghouse Marine Department at Philadelphia, and later turned his attention to commercial work.

Mr. Clark is well known in marine circles, especially in Philadelphia and Baltimore. He is a member of the Society of Naval Architects and Marine Engineers and also of the Engineers' Club.

"MALIA" FITTED WITH LARGER ENGINES

The Anchor-Brocklebank Line motorship MALIA is now being equipped with two new Cammellaird-Fullagar oil-engines at their floating drydock at Tranmere. The experimental set of two 500 h.p. Cammellaird-Fullagar engines which has driven this motorship since September, 1921, has been removed and two four-cylinder, two-cycle 18½″ by 25″ oil-engines developing 1,200 brake h.p. (or 1,500 i.h.p.) at 110-115 r.p.m. are being installed. These engines were especially designed for the vessel and should give her a speed of 10-11 knots.

ACCIDENT ON THE M.S. "FRITZOE"

Through an error in supplying tanks containing oxygen when tanks of compressed air were ordered, an explosion occurred on board the motorship FITZOE of the Munson Line at a shipyard in Brooklyn, on December 9, resulting in the death of her chief-engineer Joel Jensen and severely injuring several assistants.

Not knowing that a mistake had been made, the chief-engineer coupled the tanks containing oxygen in line with the vessel's own air-bottles for starting the auxiliary-engine, the whole machinery being at that time opened up for annual survey. The union of the oxygen with the air and possibly traces of oil produced the explosion, which was not in any way contributable to the vessel's own equipment.

The matter will be made the subject of a thorough inquiry upon recovery of the injured men and these findings will be published at a later date in MOTORSHIP.

NEW WEIR-SULZER DIESEL ENGINE

The firm of G. & J. Weir, Limited, Cathcart, Glasgow, Scotland, who have lately devoted considerable attention to auxiliaries for motorships, in addition to their well-known line of steam pumps, have made arrangements with Sulzer-Freres to construct the Weir-Sulzer Diesel engines, both for auxiliary and propulsion purposes. The new engine will be constructed at present in sizes from 15 to 200 brake h. p. and will be of the two-cycle port-scavenging type, the compression being held to a normal figure of 500 pounds per square inch; the scavenging-air is admitted through a single row of ports being delivered from the crank-chamber in the usual manner. The air from the atmosphere is admitted to the crank-chamber on the suction-stroke in a manner similar to that used in the usual hot-bulb engine. A water-cooled cylinder-cover provides an ignition-chamber which is in communication with the combustion-space below the automatic fuel-valve. Fuel enters the ignition-chamber through the valve and compressed-air enters from the cylinder on the upward stroke, partial ignition following which causes the rise of pressure in the ignition-chamber, leading to the expulsion of a fine atomizer charge of fuel in the combustion-chamber at the point of maximum compression.

There are two separate fuel-pumps driven by cams and rollers off the crank-shaft and the speed is controlled by a governor which alters the stroke of the pump-plungers. Starting is effected by compressed-air at about 300 pounds pressure, and where the engine is to be used for propulsion a small air-compressor is provided to be direct-driven off the engine. Only one cylinder has a starting-valve.

PASSENGER MOTORSHIP "DUMANA" LAUNCHED

The third large twin-crew motorship for the British India Steam Navigation Co., namely the DUMANA, was launched at the Barclay-Curle Shipyard, Glasgow, on November 23rd. She is part of a large fleet of Diesel-driven vessels owned by this line, several of the others being small craft, including the DUMRA and DWARKA. The other two large ships are the DURENDA and DOMALA, both of which have been referred to previously in these columns. The DUMANA has the following dimensions:

D. W. C.	10,500 tons
Passenger accommodation, 100 first-class, 50 second class	
Gross tonnage	8,500
Power	4,000 shaft h.p.
Speed	13½ knots
Length	464′ 0″
Breadth	38′ 3″
Depth to U. D.	35′ 6″

All the auxiliaries are electrically driven, efficient cargo handling gear being provided, including derricks capable of lifting up to 15 tons, and there are two derricks each having four-ton lifts. Her engines consist of two 2,000 shaft h.p. North British Diesel engines of the four-cycle type.

IMPORTANT TO FRUIT SHIPPERS

The Motorship Service Corp. has been incorporated in California with a capital of ten-million dollars to carry fruit between Pacific and Atlantic ports. Papers were filed with Secretary of State Jordan in California and the news was announced on December 12 at the Convention of California Fruit Growers and Farmers at Sacramento.

This company is headed by the former chief of the U. S. Army Transport service at San Francisco, Maj. Gen. C. A. Devol. Other directors mentioned include W. H. Morrow, Shipper, San Francisco; Walter Haas, Security Bank, Los Angeles; Walter S. Wheaton, President Pacific Import and Export Company, Los Angeles; George M. Bowles, American National Bank, San Francisco; A. R. Morrow, General Manager of the California Wine Association, San Francisco; Leonard G. Kellogg, Los Angeles, and A. J. Nicholls, of Nicholls Loomis Corporation, Los Angeles; B. R. Douglas, shipper of Oakland; Walter J. Fields, Los Angeles, and Maurice Selig, of San Francisco.

Fred N. Bigelow, Chief of State Division of Markets, submitted to the Transportation Committee of the convention a plan of cooperation with this new company, stating that it had sufficient capital for extensive water transportation. E. M. Sheehan of San Francisco, President and Manager of the California Grape Growers Exchange, and G. A. Whitcomb, of Los Angeles, Vice-President of the California Fruit Growers Exchange, are mentioned as associates with Mr. Bigelow in his proposal.

It is planned to operate twelve ships; also the construction of cold storage plants on the Pacific Coast as well as at Boston, New York, Baltimore and Philadelphia is contemplated by this company.

Diesel-Yacht "Ohio" in Commission

Largest Winton Diesel-Driven Pleasure-Craft on Long Voyage

CIRCUMSTANCES connected with the recently completed seagoing yacht OHIO demonstrate that if the owner takes precaution to have his boat built in a shipyard of known reputation, equipped with engines of demonstrated worth and designed by naval architects of established reputation, he will not be disappointed, and his expectations will be met, if not surpassed. Such performance offsets whatever feeling there may be in the minds of some yachtsmen that the promises of shipyards, engineers and naval architects cannot be taken seriously.

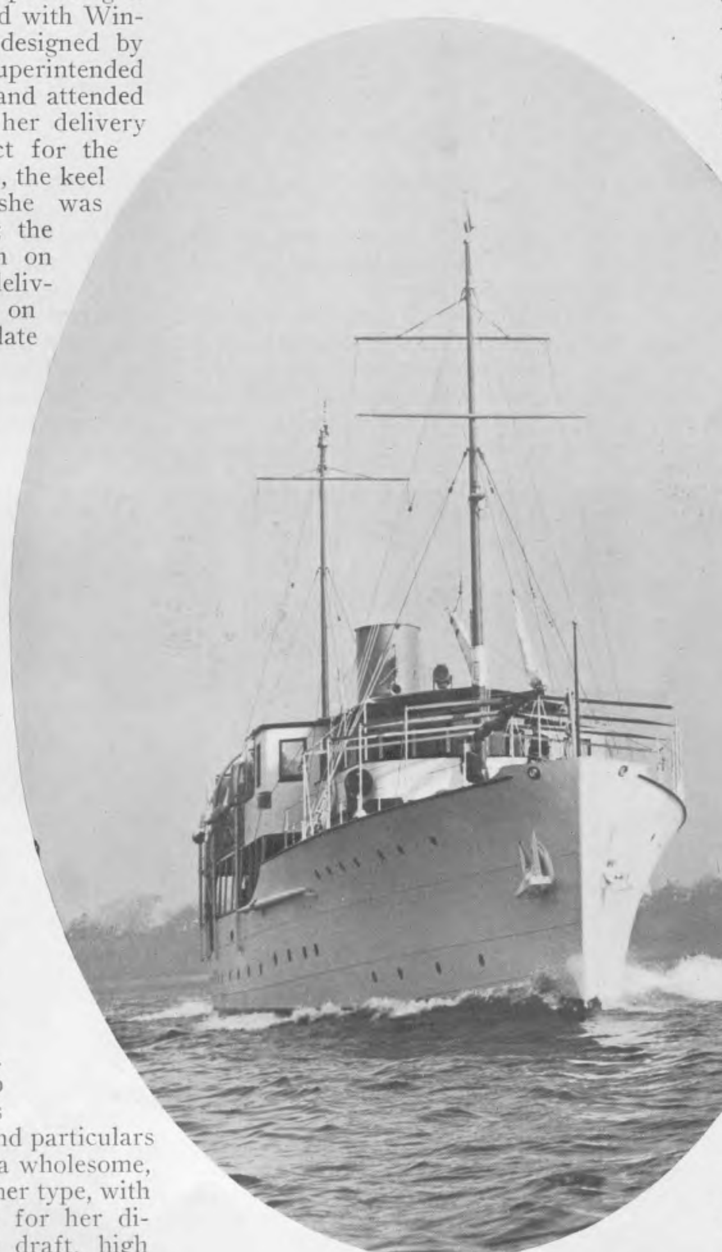
The OHIO, which was briefly illustrated and described in our November issue, has just been delivered to her owner, E. W. Scripps, of West Chester, Ohio, and was built by the Newport News Shipbuilding & Dry Dock Co. She is equipped with Winton Diesel-engines, and was designed by Cox and Stevens, who also superintended the construction of the vessel and attended to all matters connected with her delivery to Mr. Scripps. The contract for the yacht was placed on June 15th, the keel was laid on August 1st, she was launched on September 16th; the contract called for completion on November 20th, but actual delivery to the owner was made on November 15th. On this date not only was the shipyard work completed, but the vessel was completely equipped, furnished, stored and supplied with a competent crew, and in every way ready for immediate use.

Typical of the latest development of the heavily-built, full-bodied seagoing motor yacht the OHIO is particularly adapted to extended sea voyages. Possessing a cruising radius of 9,500 miles, she offers opportunity for the enjoyment of cruises to waters where fuel is not readily procurable and a steam yacht could not go because of lack of same. It may be remembered that this vessel is of the following dimensions:

Length	172 ft
Breadth	26 ft.
Draft	11 ft. 6 in.
Horsepower	700
Speed	12 knots

An inspection of the plans and particulars of the OHIO shows that she is a wholesome, able craft of the modified steamer type, with unusually heavy displacement for her dimensions, good beam, ample draft, high freeboard, short ends, and a proper distribution of weight and buoyancy. In fact, OHIO typifies to anyone accustomed to the sea, reliability and seaworthiness combined with a maximum of comfort for all on board—the officers and crew, as well as the owner and his guests.

Two six-cylinder Winton Diesel-engines of 12-15/16″ bore and 18″ stroke are installed on exceptionally rugged engine foundations, which eliminate vibration. These engines develop 350 brake h.p. each at 250 r.p.m. on a fuel consumption not exceeding 0.50 lb. per h.p. hour. Each engine is fitted with a high-pressure air-compressor, governor, fuel pumps (one for each cylinder), service fuel pump and air-starting system. The two tail-shafts are of steel with bronze sleeves shrunk on same in way of the strut and stern-bearings, which are lined with lignum-vitae. The line-shafts are well supplied with pillow-blocks. Manganese bronze propellers having three blades of 6 ft. diameter are fitted, which give the OHIO a speed of 12 knots. The auxiliaries consist of one 25 K. W. Winton D. C. 110-volt generating set to

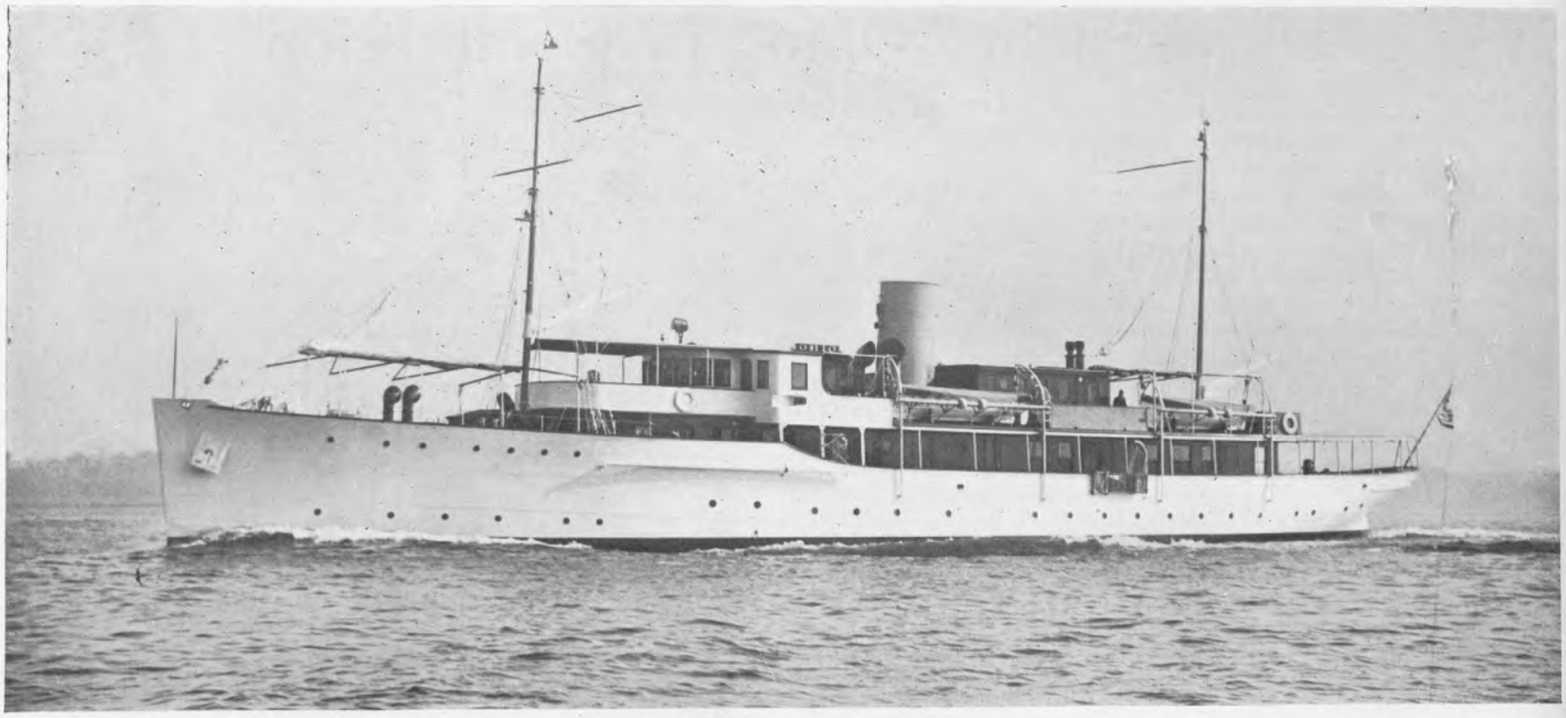


drive the main and auxiliary air-compressors and charge the storage batteries, a 15 K. W. generator set driven by kerosene engine, two Winton auxiliary air-compressors of 25 ft. per min. capacity driven by electric motor, motor-driven 2½″ bilge and fire pumps, motor-driven ¾″ fuel-service pump, oil filter and cooler, air-receiver for low-pressure or starting-air of 900 cu. ft. at 500 lbs. pressure, and two air-receivers for high-pressure or injection-air of 276 cu. ft. at 1,250 lbs. pressure, electric-driven fresh and salt water pumps, etc. Exhausts from all engines are carried to mufflers in the stack. Over each main engine is a ½-ton differential chain block running on an I-beam.

With stations throughout the boat a Western Electric type Interphone system adds to the convenience of this floating home. Some idea of the completeness of the electric lighting system may be had when it is known that there are 150 lights in the owner's quarters and 80 in the engine-room and crew's quarters, a total of 230 lights, in addition to a 20 amp. Carlisle & Finch searchlight. One hundred Edison storage batteries are installed. Steering is by hand gear. The electric anchor-windlass and electric boat-hoist were furnished by the American Engineering Co.

A striking illustration of the excellence of her design, construction and equipment is the fact that without any previous trial whatever, she left the yard of the Newport News Shipbuilding & Dry Dock Co. on the morning of November 16th—having been turned over to the owner on the previous evening—proceeded directly to sea, made the trip offshore to New York under rather heavy weather conditions, averaging 12.4 knots on the run, there being not the slightest hitch in the performance of the vessel or any part of its machinery or auxiliaries. On this run the OHIO demonstrated her seaworthy qualities, proving an exceedingly comfortable boat and having been tried out at all points of the compass, showing herself to be good not only in a beam sea, but with a sea on the quarter and ahead. Another interesting fact is that there was a total absence of vibration and noise of any sort in the living quarters or on deck, nor was there any creaking or groaning of joiner-work, notwithstanding the heavy sea conditions.

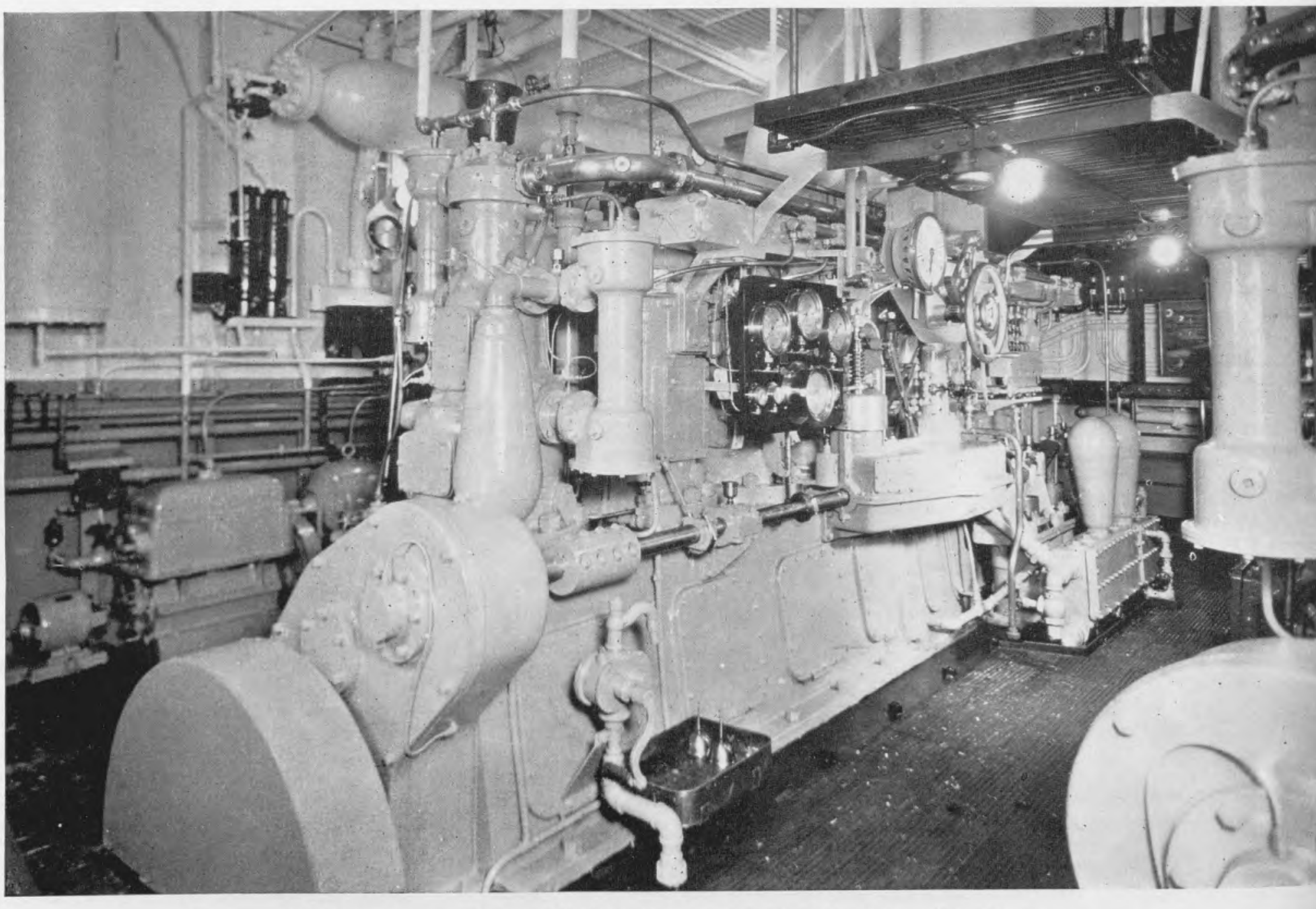
On her arrival in New York after this maiden trip, OHIO took on members of the owner's family and guests, visited certain of the ports on Long Island Sound and cleared for Jacksonville late Sunday evening, November 19th, arriving at her port of destination on Thursday, November 23rd, taking about the same time for the trip as do the steamers of the Clyde Line. This trip was entirely successful and without incident, and after taking on some other members of the party. OHIO left Jacksonville on the following morning, bound for San Diego, Cal., via the Panama Canal. It is the owner's intention after spending a short time at San Diego to make a trans-Pacific trip, and from what has already been seen of the seagoing qualities of this vessel, it would seem that this is not a venturesome undertaking in any sense, and the owner and his guests might enjoy a pleasant voyage.



E. W. Scripps' Diesel-yacht "Ohio"

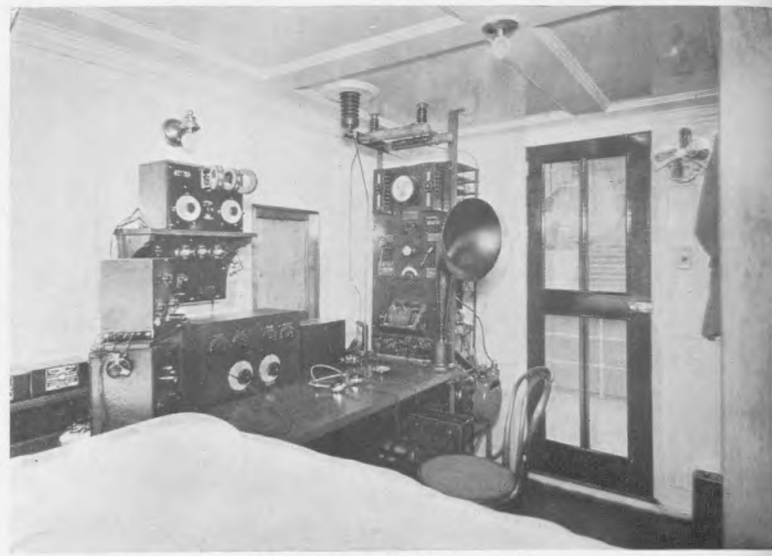
The owner's sleeping cabins are on the lower deck aft and are all large, well lighted and ventilated, and comfortably arranged. Particular attention has been paid to the arrangement of bathrooms and plumbing by the J. L. Mott & Co. The vessel is lighted throughout by electricity, quarters are heated both by hot water and electric radiators, forced ventilation is provided for all quarters, and every possible precaution has been taken to insure reliability by carefully selecting the best make of auxiliaries and by supplying as part of the vessel's equipment a complete set of spare parts for the main engines and all other machinery equipment.

Among the items of interest may be noted the fact that OHIO has nearly twice the usual capacity for generating electricity, is fitted with a cold storage space and cooled by a one-ton Clothel ice machine, and with store-rooms of all sorts sufficient for a three months' cruise, and is equipped with a laundry and a bakery. Living quarters for the officers and crew are forward of the machinery, which is situated amidships, the officers being in the upper and the crew proper in the lower forecastle. The main public rooms are in a continuous steel deckhouse, outside of which there is an ample gangway from end to end to permit exercising on long voyages, there being also a large clear deck space left of this



View in engine-room of the "Ohio," showing one of the 350 b.h.p. Winton Diesel-engines

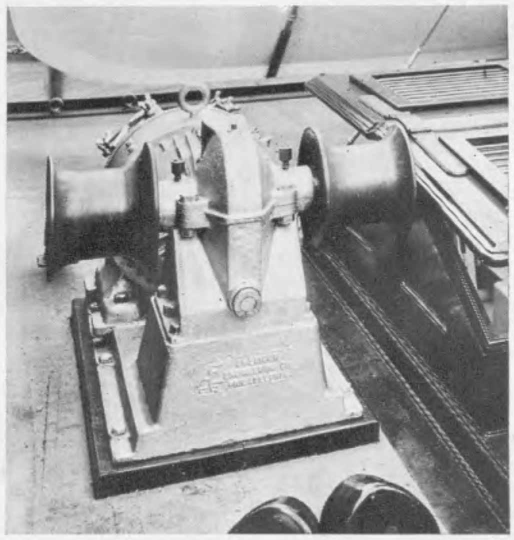
Attractive upper deck on the "Ohio"



Radio room of the "Ohio"

house and above it a continuous awning or bridge deck from end to end, thus giving in all an unusual amount of clear deck space for owner and guests, also crew. The dining room is at the extreme forward end of the main deckhouse, the after end containing a large living room with shelter space directly aft, and a continuous inside passage running between the living room and the dining room, from which access is had to the guests' quarters aft, and by means of a special stairway to the owner's own staterooms, the entrances to all the other working parts of the ship also being from this deckhouse so that access can be had, if necessary, to each and every part of the vessel without going on deck.

The main deckhouse also contains, just forward of the living room, a large and attractive library which, as well as the living room, is fitted with a fireplace, the library being finished in teak and being intended as well for the owner's special use as an office. This deckhouse also contains the pantry directly aft of the dining room—the galley being below the berth deck—two deck toilets, one for men and one for women, an officers' mess room, and the necessary store rooms for deck equipment. On the upper or bridge deck are two deckhouses, the forward one containing the Captain's stateroom as well as the pilot house and navigating room, the after house being fitted at the forward end as an office, with typewriter desks, filing cabinets, sleeping accommodations for the secretaries of the owner, the after end containing the wireless equipment and the quarters for the wireless operator.



The electric boat-hoist

As the OHIO will have to navigate in all conditions of weather and of climate, she is not only, as already described, amply heated and ventilated, but every exposed portion of the deckhouse over living quarters is fitted with awnings so that in the tropics these quarters may be as comfortable as possible. The equipment of boats is ample, there being two Kermath-engined launches, one a large and seaworthy owner's launch, the other a smaller but equally seaworthy boat for the crew.

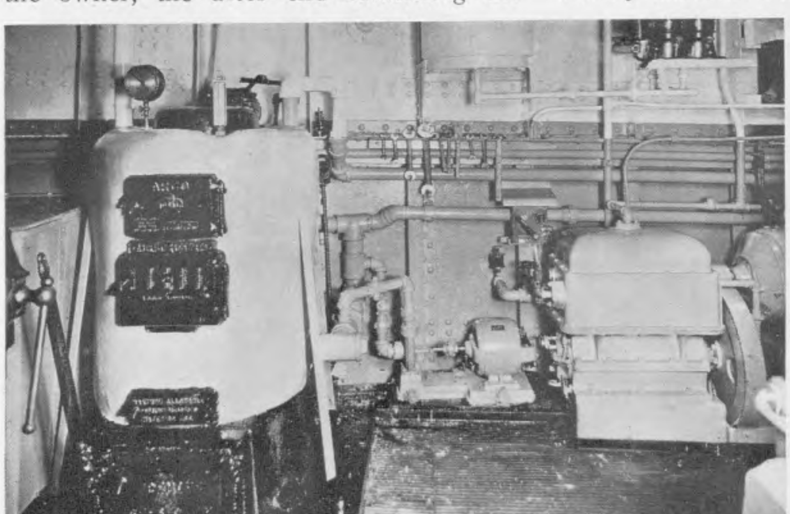
"OHIO'S" LAUNCHES ARE KERMATH-POWERED

The owner's launch is 26 ft. long of the sedan-type equipped with a 24 h.p. four-cycle gasoline-engine made by the Kermath Mfg. Co. of Detroit, while the crew's launch is 20 ft. long and has a four-cylinder 12 h.p. Kermath engine.

ELECTRIC DECK AUXILIARIES OF THE "OHIO"

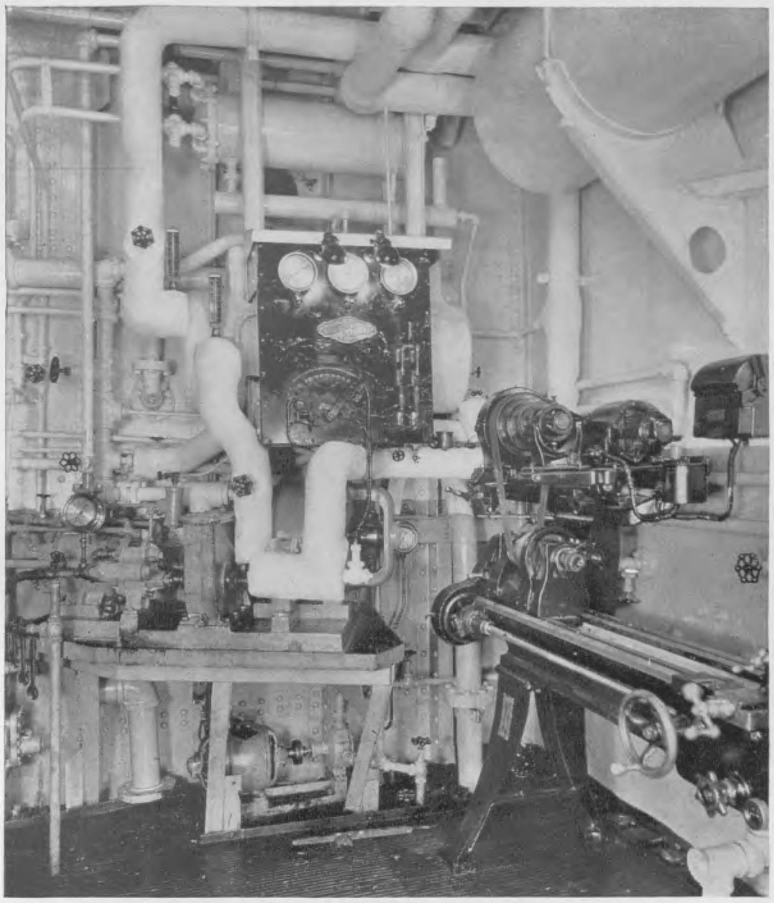
On the large Diesel-yacht OHIO electricity plays an important role, the deck-auxiliaries being electrically driven; they consist of a boat-hoist and a windlass, furnished by the American Engineering Company of Philadelphia. The boat-hoist is of the worm-driven type, with motor and mechanical parts all on deck, galvanized with the exception of the 7" polished bronze gypsey-heads, set close up to the worm-gear casing. A 7 h. p. Westinghouse motor, of the watertight marine type is used and the power developed is ample to lift the tender, a 26 foot motor-launch, through a three part fall, at proper speed.

The windlass proper is located on deck, together with the 7½ h. p. Westinghouse watertight marine motor, and all is galvanized. Galvanized ⅞" chain is used for anchor handling and such is the power of this compact worm-driven unit that it can lift both anchors and thirty fathom of chain simultaneously. This is distinctly yacht type equipment. Its successful operation is assured since the equipment is standard with this company.



One corner of the engine-room, showing the heater

Part of the galley of the "Ohio"



Some of the auxiliary equipment in the engine-room

In the "Ohio's" pilot-house

The most inviting lounge of this attractive craft

New Danish Motorship "Arizona"

Fourth Diesel-Driven Vessel Acquired by United Shipping Co. of Copenhagen

At the moment of writing the new Danish motorship ARIZONA is en route to South America via the United States with a cargo of coal from Cardiff, in which trade she will be engaged, as will the other three B. & W. Diesel-driven vessels of the United Shipping Co. of Copenhagen, namely the OREGON, CALIFORNIA and LOUISIANA. The ARIZONA has been built to Bureau Veritas registry by the Nakskov Shipyard of Nakskov, Denmark, and her machinery was constructed and installed by Burmeister & Wain.

The principal dimensions and other particulars of the vessel are:

Length (b. p.)	405′ 0″
Breadth	54′ 0″
Depth	36′ 6″
Draught (loaded)	26′ 0″
Deadweight capacity	9,100 tons
Stipulated normal average speed at sea	ab. 11 knots
Stipulated normal consumption of fuel-oil per day	9 tons
Machinery—	
Type of machinery, Burmeister & Wain's 6-cylinder, 4-cycle Diesel.	
Number of main engines	2
Cylinder diameter and stroke	590 mm. x 900 mm.
Revolutions per minute	140
Indicated h.p.	2,800
Brake h.p.	2,200

The trial results over the measured mile in the Sound November 17th, were:

Indicated h.p., average	3,132
Rev. per minute, average	144.5
Speed, average	11.215

During the consumption test, the main engines developed 2,873.6 i.h.p. at 141.4 revolutions per minute, at a fuel-oil consumption of 141.21 grammes, or 0.311 lb. per i.h.p. hour, net calorific value being 10.000 kg.cal. (18,000 B.T.U.) and included the consumption of auxiliary engines producing the necessary electric current for the auxiliary machinery, steering engine and electric light.

The machinery is placed midship and is of Burmeister & Wain's standard type for twin screw ships. The main engines are short stroke, forced lubricated cross head engines, on the front end fitted with three stage air compressors supplying the necessary injection air for atomizing the fuel oil.

All auxiliary machinery in the engine room as well as the deck machinery is electrically driven, the necessary current being supplied by three 50 K.W. Diesel-driven dynamos.

Each of the generators is sufficient for supplying the necessary current under normal working conditions at sea, whereas two or all three generators have to be started, when the consumption of current is large, i. e., when manoeuvring with the manoeuvring compressor running or when loading or unloading with the winches using current.

After the successful trial trip, the officials and the trial trip crew were landed in a tugboat, while the ship continued on her maiden voyage.

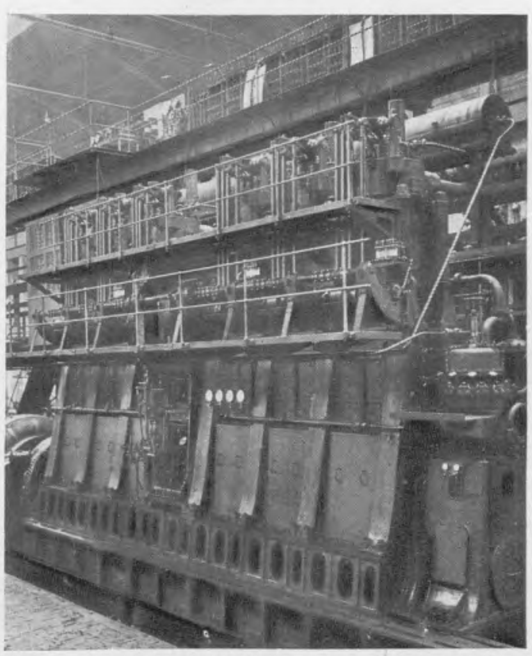
United Shipping Company's motorship "Arizona"

6,000 TONS MOTORSHIP FOR MACIVER LINE

There is under construction on the Clyde for the MacIver Line of Liverpool, a single-screw motorship of 6,000 tons, in which a 1,600 brake h.p. Harland & Wolff, B. & W. type long-stroke Diesel engine will be installed. This engine will operate at 78-90 r.p.m., and the vessel will be completed in February, when she will be placed in the South American trade.

SIX LOMBARD DIESEL ENGINES ORDERED

An order for six Diesel-type engines has been received by the Lombard Governor Co., of Ashland, Mass., from the Minnesota Transport & Navigation Co., for installation in conjunction with electric-drive in two canal-type ships. Four of these engines are of 375 b.h.p. and two are of 60 b.h.p.



One of the 1,100 brake h.p. engines of the "Arizona"

WORK OF TRAINING-MOTORSHIP "KOBENHAVN"

Since October 1st, 1921, the East Asiatic Co.'s training-motorship KOBENHAVN has made a successful voyage round the world, covering 38,000 nautical-miles without incident. She had eleven apprentices aboard. She is an auxiliary vessel of 6,000 tons d.w.c., powered with a 600-shaft h.p. Burmeister & Wain Diesel oil-engine, which was used during calms and in narrow waters. A large quantity of cargo was carried on the various stages of the journey. Among the ports of call were Copenhagen, Newcastle, Antwerp, Panama Canal, San Francisco, San Pedro, Los Angeles, Honolulu, Vladivostock, Dalny, and St. Helena. She returned to Europe via the Cape of Good Hope and the Suez Canal. In this manner this big Danish shipping and trading company secures its officers and engineers, and produces the proper seafaring spirit and discipline—an example not yet followed by American shipowners.

BURMEISTER & WAIN RECEIVE COASTWISE MOTORSHIP ORDER

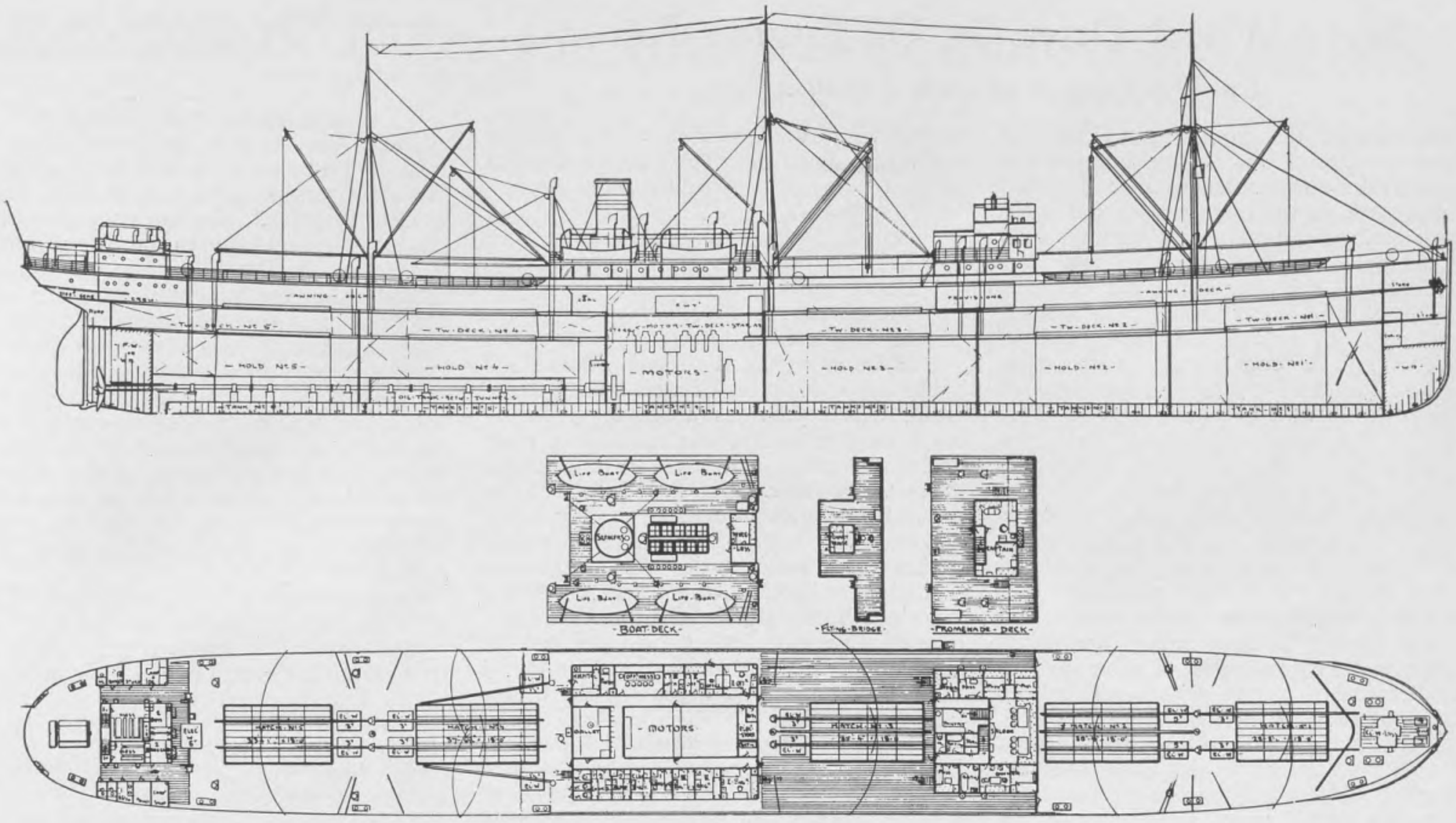
For service between Copenhagen (Denmark) and the Borneholm Islands in the Baltic Sea, a small passenger-and-cargo motorship has been ordered by the Borneholm Steamship Co. of 1886 of Borneholm from Burmeister & Wain of Copenhagen This vessel will be similar in size to a steamship built for the same company just prior to the war. Because of the difficult navigation around this rock-infested island vessels on this service have to be absolutely reliable.

This vessel differs materially from the average motorship turned out by the Burmeister & Wain plant, and will be 226 ft long o. a., 210 ft. long b. p. by 35 ft. breadth and 11½ knots speed. One report says 13½ knots speed. As yet it has not been decided as to whether the propelling engine will be of the trunk-piston or crosshead type, but it will be of the six-cylinder four-cycle model. The ship is to be delivered by April 1st, 1924, the contract sum being 1,444,500 kroners.

It is rather interesting to note that, although fuel-oil cannot be secured cheaply at her ports of call, because the same must be imported, the owners after careful calculation have decided that there will be considerable saving through economies to be effected compared with a steamer on the same route. For instance, the motor-vessel will have thirty additional cabins without any increase in the dimensions of the hull, simply due to the saving of engine-room space in the Diesel engines over the steam machinery.

SUN SHIPBUILDING CO. SECURES ANOTHER MOTORSHIP ORDER

A contract for the 1,800 tons deadweight motorship, briefly described on page 933 of our December issue, has been placed with the Sun Shipbuilding Co. of Chester, Pa., by the Standard Transportation Co. of New York. Twin 300 shaft h.p. McIntosh & Seymour Diesel engines will be installed.



General arrangement p lan of the "Tennessee"

THE NEW WILHELMSEN MOTORSHIP FLEET

In addition to four large Diesel-driven freighters placed in service during recent months, namely, the TROLLEHOLM, THALATTA, TENNESSEE and TIRADENTES, Wilhelm Wilhelmsen, of Kristiania, Norway, has four more motorships under construction, namely, two of 8,000 tons and two of 6,000 tons deadweight, making a total fleet of eight vessels, aggregating 60,000 tons, as the first four are of 8,000 tons each. Building such a fleet at this time demonstrates a strong belief that no matter the condition of steamship operation it will pay to construct and keep motorships in service. Three of the completed vessels were built by Burmeister & Wain, of Copenhagen, Denmark, and the four now under construction and one in service are Duetsche Werft productions. All, however, have B. & W. type Diesel engines, those for the German boats being manufactured under license by the A. E. G. of Berlin. All are twin-screw ships except the two 6,000-ton boats more recently ordered, which will be of the single-screw class and of 1,550 i.h.p.

It is interesting to note that the Deutsche Werft also displayed confidence in the oil-engine by ordering twenty sets of 1,550 i.h.p. before they received a single motorship order.

On this page are given general arrangement drawings of the new Danish-built, Norwegian-owned cargo motorship TENNESSEE. The following are the general specifications of this interesting and economical ship.

Owner, Wm. Wilhelmsen, Kristiania.
Builder, Burmeister & Wain, Copenhagen.
Engine-builder, Burmeister & Wain, Copenhagen.
Loaded displacement, 14,995 tons.
Deadweight capacity, 10,875 tons.
Net cargo capacity on average voyage, 10,000 tons.
Contract speed (loaded) 11¼ knots.
Trial speed over mile (4,415 tons displacement on 9′ 8″ dft.) 12.59 knots.
Power, 3,100 I.H.P.
Power, 2,400 shaft h.p.
Propeller speed (designed) 125 r.p.m.
Propeller speed (over mile on trial) 144.25 r.p.m.
Propeller speed (during consumption test) 137.7 r.p.m.
Maximum power on mile run, 3,640.2 I.H.P.
Fuel-consumption on trials, 0.298 lb. per I.H.P. hour.
Daily fuel-consumption (guaranteed) 10 tons.
Engines, 4-cycle, six cyl. Diesel, 24.803″ bore x 37.795″ stroke.
Register, Lloyds 100 A1.
Auxiliaries, Diesel-electric, three 60 K.W. sets.
Winches, 12 electric.
Heating system, steam.
Maiden voyage, Göteborg to Australia.

TWO KRUPP POWERED AMERICAN YACHTS

At the Harlan Plant of the Bethlehem Shipbuilding Corporation a three-masted steel schooner yacht is under construction for a prominent yachtsman from designs by Henry J. Gielow, New York. This yacht will be—length, o.a. 119′ 6″; length w.l., 97′ 6″; breadth, 24′ 5″; draft, 7′. She will be equipped with a 180 h. p. six-cylinder 8⅝″x3¾″ Krupp Diesel-engine.

In the three-masted steel schooner UNDAUNTED (ex-Karina), owned by Addison G. Hanan, of New York, a 280-450 six-cylinder 13¾″x13¾″ Krupp Diesel-engine connected with a Krupp reversible propeller operating at 250-400 r.p.m. is being installed. It is interesting to note that this engine weighs, complete with air-bottles, coolers, filters, etc., only 38,100 pounds and is only 17′ 3″ long, thus being ideally suited for yacht work.

NEW NEPTUNE MARINE OIL-ENGINE FOR MOTORSHIP "ARNUS"

Now running tests at the Neptune Works of Swan, Hunter & Wigham Richardson, Ltd., Newcastle-on-Tyne, the first of two new type Diesel-engines which are to be installed in the motor tanker ARNUS are now completing. This engine is of the two-cycle type, with stepped-pistons, the lower pistons forming the scavenging-pumps. It develops 1,400 i.h.p. from six cylinders 17″ bore by 35″ stroke at 125 r.p.m.

Motorship "Titania" ready for launching. Second 8,000-ton motorship built for Wil. Wilhelmsen by Deutsche Werft

Stern-Wheel Drive by Oil-Engine Power

Excellent Example of Little Exploited Type

Throughout the Southern and Middle Western states of this country hundreds of shoal-draft stern-paddle wheel steamers are in daily use on the many rivers and lakes. These picturesque craft are a familiar sight on the great rivers where they run their bows against the river bank, put over the gang-plank and begin loading and unloading freight by means of a long line of stevedores. Passenger craft of this type are also the chief means of transportation from town to town in many sections. This field of the stern-wheel craft has been almost entirely one of steam propulsion, either coal or wood-fired boilers and non-condensing steam engines being the power plant, until recently the oil-burning boiler and condensing steam engines have entered in for the sake of further economy. But the internal-combustion engine with its still greater saving is superseding the steam engine, not only because of economy but also because of weight-saving, which is so important in a shoal-draft vessel.

Every excess pound of machinery weight in such an installation decreases carrying capacity, which earns profit; therefore the oil engine should prove well suited to use in such installations, as it saves the weight of water in boilers, of the boilers and much of the weight of auxiliaries. As the oil engine revolutions are higher than those of a steam engine, reduction-gear must be introduced to produce the requisite low revolutions of the stern-wheel, but as 10 to 1 reduction-gears are readily available the oil-engine driven stern-wheel is a commercial proposition.

This type of drive is well illustrated by the W. C. KELLEY, a new boat for the Kelley Axe Manufacturing Co., of Charleston, W. Va., plans of which we are enabled to publish through the courtesy of Cox and Stevens, her designers. She is now under construction by the Charles Ward Engineering Works, Charleston, W. Va., and when completed will be used to tow barges loaded with raw materials to the factory and return down the river with the finished product. Her principal dimensions are:

Length o. a. .... 106′ 3″
Length deck .... 90′ 0″
Breadth, md. .... 20′ 0″
Depth, md. .... 4′ 0″
Draft .... 2′ 3″
Horse power 200
Make of engine..Fairbanks Morse

Her construction is of steel on the truss-form, which provides a strong girder to resist stresses and strains incident to river use where snags and bars are a constant danger. By referring to the illustration the general arrangement will be readily noted and the great saving in space as compared with a steam boiler and engine installation will impress itself on the reader. For the 200 h.p. four-cylinder Fairbanks Morse oil engine requires little floor space and the shafting extends aft under the floor to the 10 to 1 worm-reduction gear by the Cleveland Worm Gear Co., of Cleveland, Ohio. Five pillow-blocks are provided for the 6″ line shaft which drives the reduction gear through spur-gear of 36″ pitch diameter. The lay-shaft is of 8″ diameter steel, the pitmans are of Oregon pine heavily strapped with steel, while the paddle wheel shaft is a hexagonal steel forging 7″ across the flat. The paddle wheels are of 13′ 0″ diameter, 14′ 6″ long, having 12 buckets 20″ wide.

In addition to the 200 h.p. Fairbanks Morse oil engine for propelling the boat there is a 3 h.p. engine of the same make driving a 32-volt generator and a Fairbanks Morse air-compresser set. No storage batteries are provided. A Gould's hand fire pump 5″ x 5¼″ is also part of the equipment. The fuel tanks have a capacity of 9,000 gallons, while 3,000 gallons of fresh water and 125 gallons of lubricating oil are carried. The field for oil engines in vessels of this character on our inland rivers is exceedingly large, and we believe that the operation of this stern-wheel tug will be such as to lead others to install oil engines for similar work.

MOTOR YACHT "LLYS HELIG"

There has recently been completed by John I. Thornycroft & Co., Southampton, England, from designs by A. T. Wall, Maas & Co., Liverpool, the motor yacht LLYS HELIG. She ran trials in the Solent during November, these trials consisting of a six hours' endurance trial at full power with six runs over the measured mile, during which a speed of 12⅝ knots was attained. During these trials weather conditions were not favorable to higher speed, but the two 180 brake h.p. Kromhout oil-engines performed to the perfect satisfaction of the builders. A notable feature of the trial was the entire absence of vibration, this being partly attributed to the fact that the engine foundations are electric welded rather than riveted.

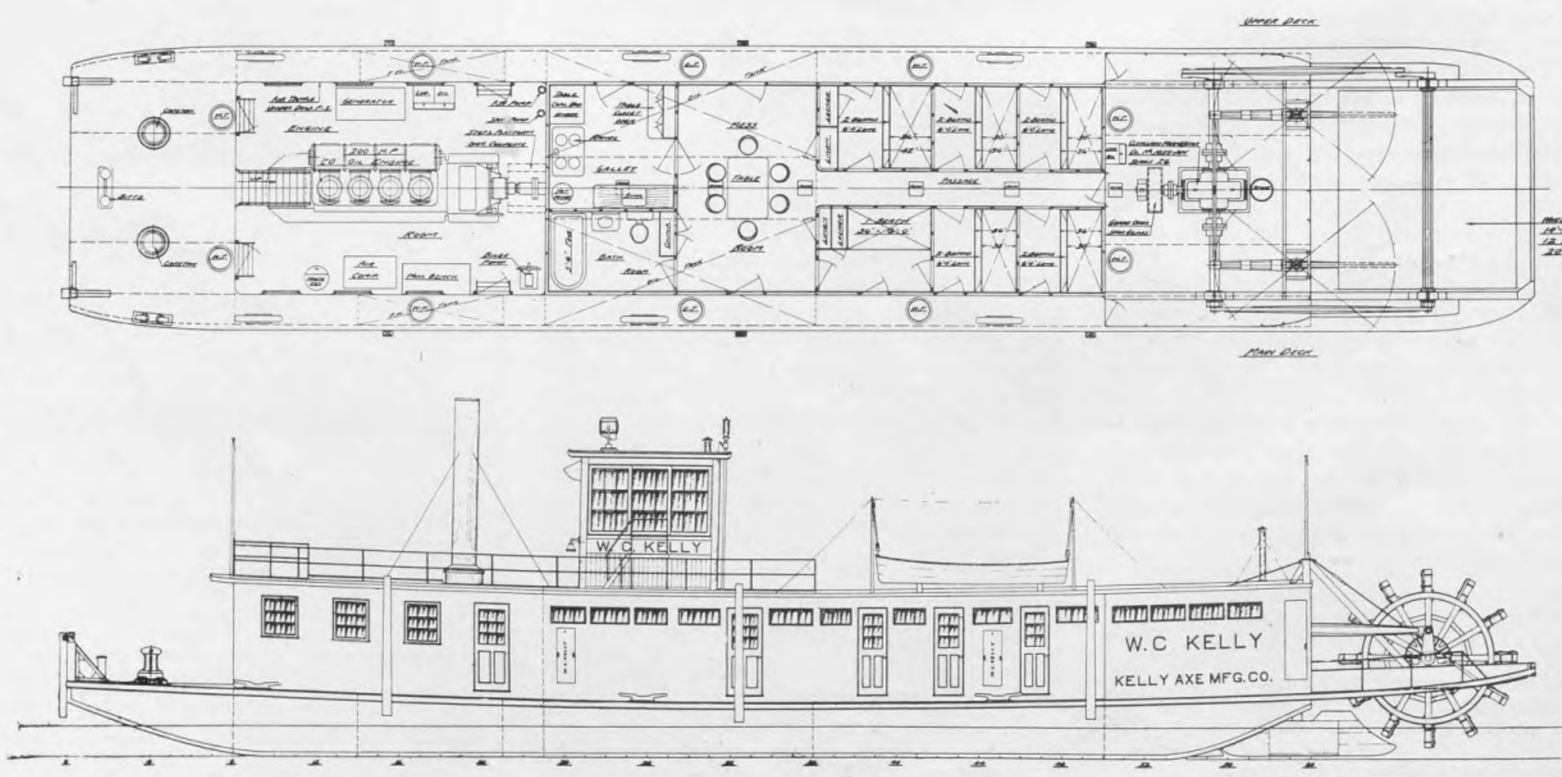
Performance on the trial trip worked out with the high propulsive efficiency of over 55 per cent. The engines were furnished by Perman & Co. of London, British agents of the Kromhout oil-engine. Another feature of the trials was the complete silencing of the exhaust, two silencers of special design being installed. All the auxiliaries are electric driven and the boat was built to the requirements of the British corporation.

CRAIG YACHT "EDYTHE" HAS NELSECO ENGINES

Through an oversight, it was stated on page 915 of our December issue that Mr. John F. Craig's motor-yacht EDYTHE was powered with Winton Diesel engines. This vessel, of course, is propelled by Nelseco Diesel engines built by the New London Ship & Engine Co., of Groton, Conn.

NEW MIANUS MOTOR YACHT

Now under construction at the Luders Marine Construction Company, Stamford, Conn., is a 94 ft. motor yacht for C. Prescott Knight of Providence, R. I. She is from designs by J. Murray Watts of Philadelphia and will be powered with two 120 h.p. Mianus oil-engines.



Stern-wheel motor-tug "W. C. Kelley"

Revision of Rules for Internal-Combustion Engines

By JOSEPH HECKING
Technical Staff, American Bureau of Shipping
Courtesy of the American Bureau of Shipping

SINCE the publication of the Rules for Internal Combustion Engines in January, 1921, the various requirements pertaining to the construction and installation of such engines are being kept under continuous observation by the Surveyors to the Bureau in order to keep step with the advance in the art of building oil engines and to make such modifications in the Rules as may be warranted by experience. In the 1922 issue of the Rules, now ready for distribution, the requirements for line-shafts and air containers for Internal Combustion Engines, Section 36, have been modified to such an extent as to deserve the particular attention of those interested in the subjects.

Lineshafts—While in the original Rules the effect of the flywheel in equalizing the torque and consequently its influence on the shaft diameter has been taken care of in a general manner, i.e., for average conditions, a thorough analysis of the rather involved subject revealed the fact that such a general procedure is liable to be unjust or unsafe. The principal reason for this unsatisfactory condition is the fact that usually the formulas for lineshafts are based on the mean indicated pressure as a percentage of the maximum initial pressure. The inadequacy of this procedure can readily be ascertained from normal power indicator cards taken from engines of various types. The mean indicated pressure, representing the mean torque for which shaft diameters are calculated, is to a large extent independent of the initial (maximum) pressure, even for engines of the same type, and the ratio of mean indicated to maximum pressure depends largely on details of design and the attitude of the designer.

In the revised formula the mean indicated (cylinder) pressure has been taken as the basis and the derivation of the formula is given in the following:

p = Mean indicated pressure (from indicator card) per sq. in. cylinder area.
pc = Mean turning pressure on crankpin, per sq. in. cylinder area,
r = Length of crank in inches $= \frac{S}{2}$,
D = Diameter of cylinder in inches,
S = Stroke of engine in inches,
d = Diameter of shaft in inches.

The mean cylinder pressure × length of stroke equals the mean turning pressure × length of crank-path per cycle.

For a 4 cycle engine $p \times 2r = pc \times 2r\pi \times 2$ (2 revolutions) and $pc = .16\,p$.
For a 2 cycle engine $p \times 2r = pc \times 2r\pi$ (1 revolution) and $pc = .32\,p$.

The mean turning moment or torque for a 4 cycle engine =
$.16\,p \times .7854\,D^2 \times S/2 = .0625\,p\,D^2S$;
the mean torque for a 2 cycle engine =
$.32\,p \times .7854\,D^2 \times S/2 = .125\,p\,D^2S$.

The section modulus for a circular shaft subject to torque is $.196\,d^3$ and the resistance of the shaft, under a fibre stress of 5000 lbs. per sq. in., $.196\,d^3 \times 5000$.

The torque is equal to the resistance.

For a 4 cycle engine $.196\,d^3 \times 5000 = .0625\,p\,D^2S$; $d = .683\sqrt[3]{\frac{pD^2S}{5000}}$

For a 2 cycle engine $.196\,d^3 \times 5000 = .125\,p\,D^2s$; $d = .681\sqrt[3]{\frac{pD^2S}{5000}}$

The above formulas apply to a single cylinder operating on either the 4-stroke or the 2-stroke cycle.

In multi-cylinder engines each cylinder is designed to contribute an equal amount to the total power. The mean torques of the various cylinders are, therefore of equal magnitude and in order to make the shaft diameter suitable for the combined torques the torque factor in the foregoing formulas must be multiplied by the number of cylinders, N; thus

$$\text{for 4 cycle engines } d = .683\sqrt[3]{\frac{p\,D^2\,S\,N}{5000}} \quad (1)$$

$$\text{for 2 cycle engines } d = .861\sqrt[3]{\frac{p\,D^2\,S\,N}{5000}} \quad (1)$$

These formulæ assume a uniform torque. The turning efforts of oil engines during the period of a cycle are, however, far from uniform and shaft diameters must be designed to resist the maximum torque. In order to equalize the torque flywheels are fitted, having the property to absorb effort when the torque is above the mean and surrender the absorbed effort when the torque is below the mean. The greater the flywheel effect the more uniform the running of the engine. Irregular turning efforts manifest themselves by increasing or decreasing the velocity of the crankpin in relation to the mean velocity. The energy E stored in a flywheel is expressed by the formula:

$$E = \frac{WV^2}{2g}, \text{ wherein}$$

W = Weight of flywheel in lbs.
V = Peripheral velocity of the center of gravity in ft. per second.
g = Acceleration due to gravity = 32.16.

All energy is developed during the power stroke, causing a maximum velocity, V max., of the crankpin near the end of the power stroke. This energy is absorbed during the whole cycle, causing a minimum velocity, V min., near the beginning of the power stroke. The energy represented by the difference between V max. and V min. is to be absorbed and then surrendered by the flywheel, and since it is impossible to provide sufficient flywheel effect to make V max. equal to V min., a certain fluctuation in velocities will remain. Denoting the fluctuation C as a percentage of the mean velocity V, the energy E stored in a certain flywheel is

$$E = \frac{WCV^2}{g}.$$

If E = Energy in inch-lbs.,
W = Weight of flywheel rim in thousands of lbs.,
F = Outside diameter of flywheel in ft.,
R = Revolutions per min.,
C = Speed fluctuation,
then $E = W\,C\,F^2\,R^2$ (approximately.)

The values of E can readily be determined from the turning effort diagrams. It is the difference between the total energy developed during the power stroke and the uniform resistance during this stroke. It would lead too far to publish here the method of constructing the diagrams; the results obtained for average safe conditions are given below. While the values are those obtained from turning effort diagrams of Diesel engines, investigation has shown that they may also be used for engines of other types, the slight reduction permissible in some instances being negligible, excepting cases where refinement is desirable.

$$E = KD^2PS = WCF^2R^2$$

D = Diameter of cylinders in inches,
P = Maximum cylinder pressure in lbs. per. sq. in.,
S = Stroke in inches,
K = Variable taken from the following table.
For other terms see above.

Values of K

No. of cyl.	1	2	3	4	6	8	12	16
4 cycle	.190	.155	.135	.060	.045	.045	.015	.005
2 cycle	.155	.055	.055	.045	.015	.005	...	...

From the above noted formula the fluctuation formula is obtained:

$$C = \frac{KD^2PS}{WF^2R^2} \quad (2)$$

The torque is in proportion to the velocity squared. The fluctuation C is the difference in the velocities above and below mean velocity in relation to the mean velocity, and the values above and below are equal. Formulas (1), or the torque values therein are based on uniform velocity V; for calculating shaft diameters the maximum torque is to be considered, which is a function of the mean velocity plus the fluctuation *above* mean velocity, $\frac{C}{2}$. Denoting uniform velocity as 1, the maximum torque is expressed by the formula on the following page.

The fibre stress of 5,000 lbs. in the above formulas represents the regular marine steel of 60,000 lbs. min. T. S.; where material of 70,000 lbs. min. T. S. is used, 5,300 may be substituted for 5,000.

For a complete analysis see *Marine Engineering and Shipping Age,* November, 1922.

Air Containers.—Experience has proved that the test pressures required for air containers are setting up considerable bending stresses in the plates of lap-riveted joints, tending to open the caulking edges. While the plate thickness required by the formulas are adequate for double butt joints, the thicknesses for lap-riveted joints have been increased. The following paragraph has been added to paragraph 46, Section 36:

Riveted longitudinal joints should be of double buttstrap type, the inner strap ex-

(Continued on page 52)

Puget Sound's Fastest Oil-Engined Passenger-Boat

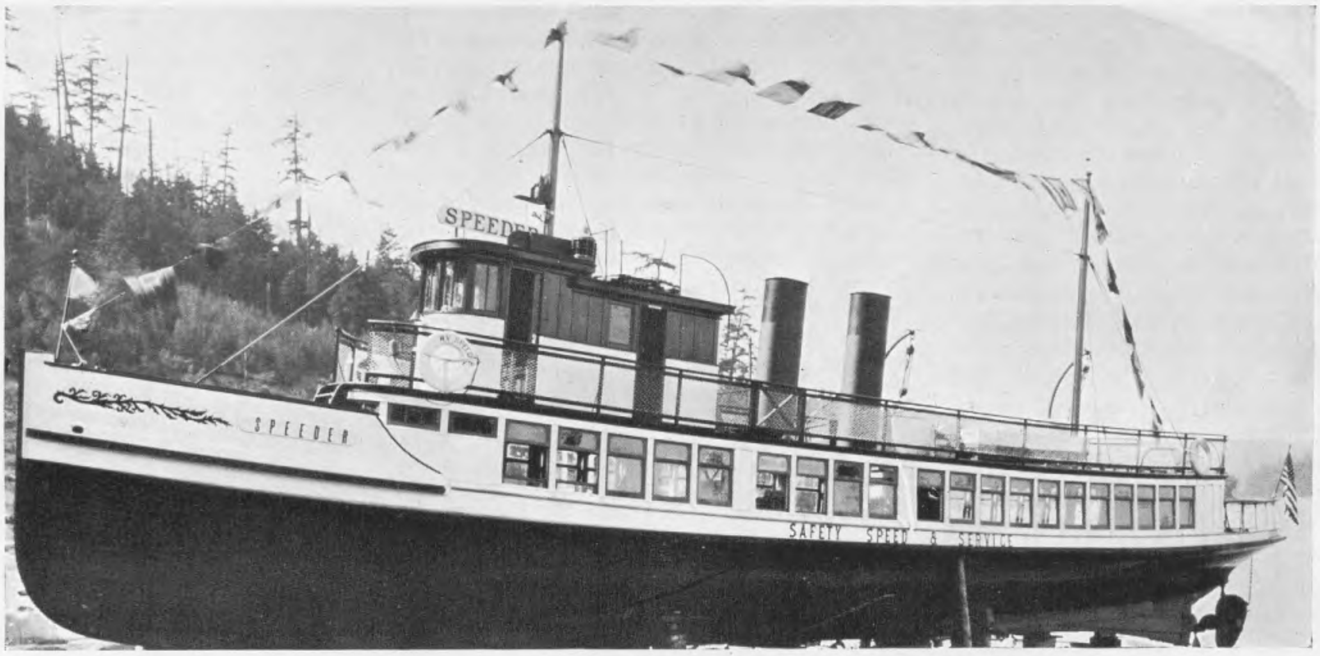
The "Speeder" Represents a Type Worth Noting

ONE of the claims made by those who oppose the general adoption of oil-engine power is that it is limited to slow-speed craft. That this claim is not valid, we, who are best acquainted with the use of oil-engines in marine service, realize, but it appears necessary at times to bring forward concrete examples of the economical employment of this propelling power in vessels of relatively high speed. As such examples multiply it is hoped that the true limitations of oil-engine power for marine-propulsion will be more generally understood. Therefore, considerable interest should be evident in the case of Capt. Norman L. Driggs' passenger-boat SPEEDER, which attains the speed of 16 miles an hour. This new Puget Sound craft is of wooden construction of the following dimensions:

Length o. a.	87 ft.
Breadth	13 ft.
Draft	3 ft. 6 in.
Horse power	90 h.p.
Speed	16 miles

Capt. Driggs has long operated steamers in the passenger service, but became convinced that the more economical internal-combustion engine could be utilized without loss of speed, so essential in passenger-craft. He therefore investigated and finally ordered the SPEEDER of the Jensen Shipyard, Friday Harbor, Wash., and a 90-126 h.p. Gulowsen-Grei oil-engine for installation in this vessel. She was built from design by S. R. Gage and is of pleasing lines and appearance, substantial construction and attractive finish. In general arrangement she follows unique lines, the upper passenger-deck being provided with wicker chairs and a stairway leading to handsomely appointed saloons below. In these rooms the stereotyped arrangement has been varied and two cabins are provided, one at either end of the engine-room. In the after cabin are 46 upholstered opera-chair type seats facing the large windows hung with attractive draperies, and the sides of the cabins are fitted with large plate glass mirrors artistically paneled in gray-tinted ash. A Victrola of the cabinet type adds to the attraction, while card-tables and movable comfortable chairs are also provided. Operating on the beautiful waters of Puget Sound the SPEEDER touches at Friday Harbor, Deer Harbor, Orcas, Shaw, Anacortes, Port Stanley and Bellingham, connecting with practically all stages and with the morning trains for Seattle. It will thus be evident that this boat is a vital link in the passenger-transportation service of the Sound and that her failure to maintain schedule would inconvenience many. This has not, however, occurred, as Capt. Driggs writes that he has "found the engine perfect," and her schedule has not been interrupted.

The engine which makes this possible is a four-cylinder Gulowsen-Grei surface-ignition oil-engine of 9½" bore and 11" stroke, developing 90 h.p. at 380 r.p.m. and 126 h.p. at 400 r.p.m. A three-bladed 42" x 53" bronze propeller, designed and cast by L. A. Coolidge, propels her, and the fuel-consumption has been found to be six and one-half gallons of fuel-oil and two pints of lubricating-oil per hour, the total cost being 42 cents per hour. Capt. Driggs has operated both steam and distillate-engines of the same power as this oil-engine in boats engaged in the same service and found the costs to be $13 and $11, respectively, in excess of that of operating this oil-engine in the SPEEDER, the figures covering 10 hours' running in each case. It is further stated that the engine is free from carbon deposit, which Capt. Driggs attributes to the efficient operation of the McCord lubricating-oil system, there being two McCord oilers, one feeding to the bearings and the other to the cylinders. The counterbalanced crankshaft tends to reduce vibration to a minimum. Vessels of the type of the SPEEDER should be found on all our waterways where passenger boats are required.



"Speeder," attractive and economical fast motor passenger-boat

(Continued from page 51)

tending beyond the outer strap with an additional row of rivets; the thickness of the buttstraps to be not less than .625 in.; for double or treble riveted lap joints the plate thickness found by the above formula is to be increased by one-sixteenth inch. Single riveted longitudinal lap joints are not permitted.

In paragraph 55—Tests—the requirement has been added: Riveted containers are also to be tested under working pressure for two hours.

$$T \text{ max} = T \text{ mean} \times \left(1 + \frac{C}{2}\right)^2$$

Within practical limits the fluctuation values $\left(1 + \frac{C}{2}\right)^2 = (1 + C)$ nearly. The maximum torque is therefore, T (1 + C).

Adding this value to formulas (1), the following working formulas are obtained:

$$\text{for 4 cycle engines } d = .683 \sqrt[3]{\frac{p\, D^2\, S\, N}{5000}\quad (1 + C)}$$

$$\text{for 2 cycle engines } d = .861 \sqrt[3]{\frac{p\, D^2\, S\, N}{5000}\quad (1 + C)}$$

Among the Motor Work-Boats

REMARKABLY SUCCESSFUL NEW YORK MOTOR-TUG

One of the most important concerns engaged in general engineering and contracting in New York harbor is George B. Spearin, Inc., of that city, operating a number of craft in this work. Among them the MAY stands out pre-eminent, the smallest of the fleet. Her distinction is due to the fact that she is powered with an oil-engine and operating so economically that since its installation less than a year ago she has saved much fuel expense. In fact, she has already paid for the cost of the Fairbanks Morse oil-engine which replaced the former gasoline engine. The MAY is a small wooden harbor tug-boat of extremely substantial construction designed to withstand the hard service incidental to towing heavy barges, pile-drivers, scows, logs, etc., and lying alongside docks and piling in rough water. She is of the following dimensions:

Length	45′
Breadth	15′
Draft	5′ 6″
Horse power	100
Make of engine, Fairbanks Morse	
Gross tons	9

Following the removal of the old engine and the installation of her new four-cylinder 100 h.p. Fairbanks Morse oil-engine by her present engineer, David Walsh, the MAY went into service on March 14th, 1922. Since that date she has been constantly in service an average of thirteen hours each day, with headquarters at Bayonne, N. J., on the Kill von Kull, opposite Sailors' Snug Harbor, Staten Island. Engineer Walsh is authority for the statement that since going into commission the MAY has never had an accident, nor have any spare parts or new electric-plugs been fitted, and that she has always operated with satisfaction in the most severe towing done in New York harbor. We are also advised that her total cost of operation with the former gasoline-engine and with one man who acted as captain and engineer, was $2.25 per hour. Now this cost, including two men, captain and engineer, is only 65 cents per hour. Capt. Thomas Brown commands the MAY.

In installing the oil-engine, Engineer Walsh fitted two 8″ x 12″ oak engine bearers extending the full length of the boat, these being riveted to the frame of the tug and raised the engine 0.006″ above the extended center-line of the shaft. This allowed for settling of the boat when launched. The solid engine-bed eliminates vibration, and the true alignment of the shaft and engine has been responsible for the lack of hot-bearings, of which she has been exceptionally free. In warm weather 8 gallons of 28 degree Baumé Gulf Refining Co.'s oil, costing 5 cents per gallon, and one-half gallon of Mobile B Vacuum lubricating-oil are consumed, while in cold winter weather 36 degree Baumé oil is used. Her 100 h.p. Fairbanks Morse oil-engine swings a three-blade propellor of 46″ diameter and 34″ pitch at 340 r.p.m. She is a good exponent of the value of oil-engine power for harbor-tugs, and her record should go far toward convincing other tow-boat operators of its advantages.

Among the most recent installations of Atlas-Imperial Diesel-engines are the following:

The tug FALCON, owned by the Tacoma Tug & Barge Co., Tacoma, Wash., is now equipped with a 165 h.p. engine.

In the tug HALFORD the Bay Cities Transportation Co. of Oakland, Cal, has installed a 90 h.p. engine.

The Bay & River Dredging Co. of San Francisco, Cal., has had a 90 h.p. engine installed in their tug JERSEY.

Two boats owned by the Rhodes Jamieson Co. of Oakland, Cal., have been equipped with 150 h.p. engines, i. e., a stern-wheel tow-boat and a sand and gravel dredger.

Two 90 h.p. engines are being fitted in a tow-boat for the E. K. Wood Lumber Co. of Bellingham, Wash.

John Egenhoff, Marshfield, Ore., has ordered a 65 h.p. engine for his tow-boat.

The Schacht Fish Co., Sandusky, Ohio, have built a new fishing-tug, and have installed a 55 h.p. engine.

A 90 h.p. engine is being installed in a new fishing-tug for the United Fisheries Co. of Sandusky, Ohio.

In the cannery-tender ESTEBETH of Juneau, Alaska, a 90 h.p. engine has been installed.

Two new installations of Mianus oil-engines in oyster-boats are reported, one being a 60-80 h.p. engine in the Sea Coast Oyster Co. boat VERNIE, which will be lengthened several feet at the time the engine is installed. This order is the result of the economy which the 90 h.p. Mianus oil-engine effected in the SEA COAST, owned by this same company, which engine permitted filling of the fuel-tanks once a month, whereas they had been filled and their contents consumed each week.

Another installation in an oyster-boat is that of a 40-60 h.p. Mianus oil-engine in the sloop FLORENCE ERRICKSEN owned by Newcomb Bros. and Capt. Samuel Erickson of Bivalve, N. J.

Two 60-80 h.p. Mianus oil-engines are being installed in the new steel survey-boat BELTRAMI for the Mississippi River Commission building by John Elchleay, Jr., Co., of Pittsburghh, Pa.

On the East Coast Fairbanks Morse & Co. have completed a number of work-boat installations, among them the following:

The Delaware Bay and River Pilots Association of Philadelphia has installed a 100 h.p. Fairbanks Morse oil-engine in their 97 ft. by 20 ft. pilot schooner J. H. EDMONDS.

The Delaware Dredging Co. of Philadelphia tug KARD has been fitted with a 100 h.p. Fairbanks Morse oil-engine in place of a 140 h.p. gasoline-engine which was removed. She is 50 ft. long, 15 ft. breadth and 6 ft. draft and swings a 48″ by 34″ propeller which drives her 9 knots.

In their lighter ATLANTIC the Valvoline Oil Co. of New York have installed a 60 h.p. Fairbanks Morse engine. This lighter is 60 ft. long, 16 ft. breadth and 5 ft. draft.

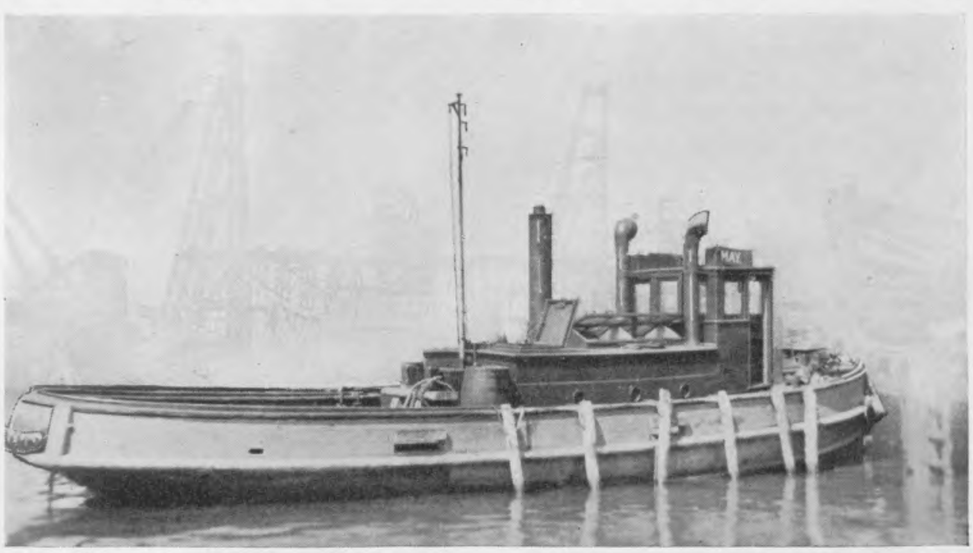
The United States Quarantine Boat, U. S. BRATTON, operated in New York harbor is the latest government craft to be modernized by the substitution of a 100 h.p. Fairbanks Morse oil-engine in place of the 120 h.p. gasoline-engine formerly installed. She is now faster and more economical. The U. S. BRATTON is 61 ft. by 16 ft. by 7 ft. and the work of removing the old and installing the new engine was done by the New York Harbor Dry Dock Co. of Rosebank, Staten Island, New York harbor.

In the new dredger built for Fred L. Ball by Nunes Bros., of Sacramento, Calif., a 110 h.p. Frisco-Standard oil-engine has been installed. This boat is 64 ft. 6 in. long, 16 ft. breadth and 6 ft. draft.

Two 90 h.p. Atlas-Imperial Diesel-engines have been installed in the V-3, former submarine-chaser, now the property of F. J. Wood, president of the E. K. Wood Lumber Co., of Bellingham, Wash. She is used for cruising, having been converted into a luxurious motor-yacht.

Two 45 h.p. Kromhout oil-engines are to be installed in a twin-screw motor-lifeboat just ordered by the North and South Holland Life-Saving Co. from the Netherlands Shipbuilding Co. of Amsterdam. She will replace the BRANDARIS, which was wrecked.

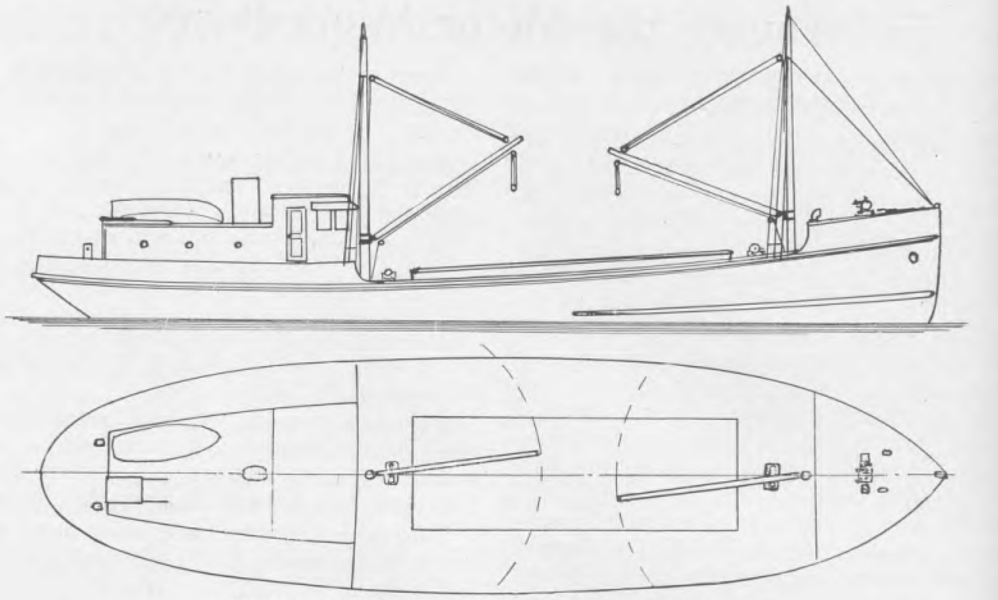
N. V. Scheepsbouwerf's Lands Welvaren, of Vlaardingen, Holland, have been ordered by K. V. D. Ley, Groningen, to convert the seagoing vessel ALBATROS of 86 gross tons into a motorship by installing a single-cylinder 45 h.p. Bolnes oil-engine.



The Motor-tug "May"

Our Workboat Forum

Technical Questions Concerning Oil-Engined Workboats Will Be Answered in These Columns. When an Immediate Reply Is Required, a Stamped and Addressed Envelope Should Be Enclosed



Design of barge to meet T. G. E.'s requirements

BUILDING A 225 TON MOTOR BARGE

To the Editor of MOTORSHIP:

WE contemplate having a boat built to carry heavy machinery, building materials, pipe, lime in barrels, etc., from our works to the city, a distance of 16 miles. In order to keep our plant running right we plan to load 225 tons in each shipment and would like to have the boat make speed enough to make the round-trip inside the 8-hour day, so as not to have to pay overtime. Cargo will be loaded on board ready to start the first thing in the morning. About half the time she will be only partly loaded, but we want the above capacity. Owing to a sandbar near our works over which she must pass she must not draw over 8 ft. loaded. She will require to discharge her cargo and place it on a dock which is 10 ft. above low-water mark. Occasionally she will have to run up Long Island Sound fully loaded in any weather existing. Please outline what we need for such service.—T. G. E., New York.

The most economical and serviceable vessel for you to build is a motor-barge along the lines of the accompanying sketch and of the following dimensions: Length o. a., 105 ft.; length w. l., 90 ft.; breadth, moulded, 24 ft.; depth, 9 ft. Such a craft will carry 225 tons on 8-ft. draft, and she will be seaworthy for the trip on the Sound, as well as a good carrier without being "boxy." A speed of 7 knots is economical and can be obtained with Diesel or other type of oil engine developing 100 to 125 b.h.p. at not over 300 r.p.m. Fuel for such an installation will cost today only about 50 cents per hour, and an auxiliary oil-engine driven electric-generating set will provide current for lights and for electric-hoists on deck for loading and discharging. A crew of captain, engineer and two deckhands would be right for her. She would be able to make a round trip and discharge cargo inside 8 hours, except occasionally when meeting unusual delay, and could be built of either wood or steel, preferably the former.

TOW-LINES FOR TUG-BOATS

To the Editor of MOTORSHIP:

I am told that motor-tugs are hard on tow-lines; that they start up with a jerk, which suddenly stretches the towing-ropes and often breaks them. A steam-tug, I am told, starts up gradually and the strain is taken up gently. Is this true?—L. K. M., Boston, Mass.

We, too, heard this argument of the pro-steam people, but on investigation and discussing this question with operators of tow-boats who have run steam-tugs and now operate oil-engined tugs we find that there is no truth in it. On a tow-boat having any kind of propelling-engine a poor deckhand can so handle the lines that he throws a sudden strain on the rope, rather than easing the line on the bitts or capstan so as to take the strain gradually. Motor-tugs are increasing in number and size every day and they are now being equipped with electric towing-machines which equal in efficiency the best steam-tug's equipment.

CONVERSION OF DUMB-BARGE

To the Editor of MOTORSHIP:

Sometimes it occurs to us that, while one or two of our several dumb-barges are lying in the stream waiting for the completion of loading of other barges before the steam-tug can proceed to sea, we are losing valuable time. Would it pay to equip these barges with oil-engines so that they could come and go whenever loaded without waiting for the tug and the balance of the fleet? Our route is a coastwise run of about 300 miles.—A. T. Co., Philadelphia.

It would probably pay to install engines in these barges and avoid delays awaiting the tug, provided sufficient power were selected. It would not pay to install power if a small engine is fitted which would only drive the barge three or four miles an hour, as a stiff breeze and heavy sea would prevent proper progress. It has been too customary to consider first cost only and install a small engine in a big-bodied craft. Such engines are ever at constant overload and trouble soon develops. In our October issue, on page 700, we published an article about the DANIEL M. MUNROE, *which was converted into a motor-barge by the installation of two 160 h.p. Bolinder surface-ignition oil-engines. It is our opinion that higher power would prove more economical in this craft, as her speed is only 6 knots.*

If you will advise the dimensions of your barges, we will suggest power for 8 knots speed for them, which is practically the lowest which should prove generally economical. Each individual case has to be decided by itself, but if your barges are of the usual coastwise type they can be powered with an oil-engine for a speed of 8 knots. By being able to leave dock upon completion of loading and proceed at this speed your motor-barge would be at her destination before she would if she were one of a string of barges towed by a tug. Also upon arrival she would not be required to lay at anchor awaiting a tug to dock her. Being provided with power, she could also discharge cargo without depending upon the derricks on the dock. If your present dumb-barge breaks loose from a fleet in a storm, as often happens, she is helpless and may be a total loss; as a motor-barge, she does not meet with this danger. In addition to the cost of fuel and lubricating-oil must be added the wages of an engineer, assistant engineer, and two others. As to whether it would pay in the case of an individual barge to install power depends upon how much delay is experienced now, time which can be saved, value of cargo and of quick delivery of same, etc.

The Bolinder-engined motor-barge "Daniel M. Munroe"

Interesting Notes and News from Everywhere

Two motorships of 6,500 d.w.c. each are to be built for the Mitsui Bussan Kaisha.

CARIA is the name of the Anchor-Brocklebank coastwise vessel originally placed in service under the name of FULLAGAR.

In the modified Italian subsidy bill there is a clause providing a maximum of 700 lira per ton for the completion of cargo ships with oil-engines.

The Johnson Schultz Towing Co. of Anacortes, Wash., is to install a 45 h.p. Fairbanks Morse oil-engine in their tug LORENS.

An order for a 5,000-ton d.w.c. Diesel-driven tanker has been received by the Götaverken of Göteborg, for delivery in the Fall of 1923.

A report has emanated from Japan that 300,000 tons of steamers will be converted to Diesel power by the Kokusai Kisen Kaisha.

Hugo Stinnes' new 8,800 tons motorship EMILE KIRDORF will operate in service between Hamburg, Rotterdam, Antwerp, and the Far East.

CARMAN, a Belgian owned 350-ton auxiliary-schooner powered with a 130 b.h.p. Kromhout oil-engine has been sold to Dutch owners. She was built in 1917 at Foxholl.

In addition to the Tosi-Diesel engine the Thomson-Houston Co. of Paris, France, manufacture a surface-ignition oil-engine for marine and stationary purposes.

On her maiden voyage from Hamburg to the West Coast of South America, the Cosmos Line's new motorship ISIS had 5,052 tons of general cargo aboard when she passed through the Panama Canal.

The Lakeside Launch Service at Sandy Beach, Lakeside, Ohio, operates a 60 ft. by 14 ft. passenger-launch driven by a four-cylinder Dodge oil-engine. Another motor boat is contemplated.

An oil-engined fire-boat has just been put into service at Marseilles, France, at a cost of Fr. 400,000. The two steam-driven fire-boats previously in service took thirty minutes to work-up full steam.

In the new 78 ft. motor-vessel HOLLANDIA building by Honweiling yard of Delft, Holland, a 36 b.h.p. A.E.G. (General Electric Co., of Germany) oil-engine is being installed. The craft will be used by Kruit-Breil & Co. in the river trade.

In the second of the two Lake-type ships, which is being converted from steam to McIntosh & Seymour Diesel power for the Munson Line at the Sun Shipbuilding yards, Winton Diesel driven electric auxiliaries will be installed.

Bassi & Holm's halibut-schooner HELGELAND, in which a 125 h.p. distillate-engine was replaced by a 100 h.p. Fairbanks Morse oil-engine, recently ran satisfactory trials at Seattle. A speed of 10½ miles an hour was attained.

Last year we published designs for a 300 b.h.p. oil-engined tug to be built for the Diamond P. Transportation Co. of Philadelphia, from designs by Edward A. Edwards. We understand that the order has recently been placed with the Clinton Shipbuilding & Repair Co. of Philadelphia.

A twin-screw motorship of 5,000 shaft h.p. with engines turning at 85 r.p.m. has been ordered by the Norddeutscher Lloyd (North German Lloyd Steamship Co.), of Bremen. The engines are of the Sulzer two-cycle Diesel type, and are being built at the Ludwigshafen plant of Sulzer Bros.

The North-East Coast Institution of Engineers and Shipbuilders are considering devoting even greater attention than ever to papers on the internal-combustion engine, although one-quarter of those recently read at their session were devoted to such engines.

Arthur D. Story of Essex, Mass., is building a fishing schooner for Capt. Frank Silvera in which a 45 h. p. Fairbanks Morse oil-engine is to be installed. She will be named A. PIATT ANDREW, and will be of 75 ft. length o. a., 62 ft. w. l., 18 ft. breadth, 8 ft. 6 in. depth of hold and 9 ft. draft.

Some time ago we reported that a motor-ferry was to be built for service between Anacortes and Sidney, B. C. We understand that Capt. H. W. Crosby, President of the Victoria-Anacortes Ferry Co. of Victoria, B. C., has called for bids on a 146'x 34'x6', 12-knot ferry to be propelled by a 500 shaft h.p. Diesel engine.

The Williams Steamship Company's motorship KENNECOTT arrived in Seattle the first week in December from the East Coast with 1,200 tons of general cargo and will load three million ft. of lumber, 750 tons of copper and other freight in Seattle, Tacoma, and Grays Harbor for New York, Philadelphia, Baltimore and Norfolk.

Now under construction at the Yarrow Shipyard, Glasgow, is a shallow-draft passenger vessel to be propelled by twin Gardner surface-ignition oil-engines of 340 b.h.p., each at 320 r.p.m. This vessel will operate at the Yangtze River in China, and will have to use Tarakan crude oil of 0.946 specific gravity as fuel.

C. A. Scharberg's freight and passenger-boat SINU, powered with a 100 h.p. Bolinders oil-engine, has been operating satisfactorily at Cartagena, Colombia, since she was built in 1917. At her usual speed of 8.5 knots carrying 100 tons of cargo, the fuel consumption is 59.2 lbs., or 0.592 lbs. per shaft h.p. hour.

Wilhelm Wilhelmsen, ship owner of Tonsberg, Norway, who has ordered and has in part operation a large fleet of motorships, has sold the steamers TRAFALGAR and TIMES to Jens Lund & Co. of Tonsberg. It is interesting to note that the more motorships shipping firms operate the more quickly they dispose of their steamers.

At a meeting of the North East Coast Institution of Engineers and Shipbuilders held at Newcastle-on-Tyne, December 1, Harold Moore read a comprehensive paper entitled "Some Factors Affecting the Utilization of Heavy Oils in Internal-Combustion Engines." Such analysis of problems connected with the use of heavy fuel-oils and tar oils is extremely timely.

A motor trawler of 600 shaft h.p. has just been built in England to the order of the Grimsby Motor Trawling Company for fishing in the North Sea. She is 115' long with 22' breadth and 13' moulded depth. For propelling power there is a 6-cylinder Beardmore surface-ignition oil engine of 600 b.h.p. The cylinders have a bore of 17", by 20" piston stroke.

Her cargo of benzine exploding, the German motorship LEOPOLD DAVID, owned by William Boestler of Hamburg, blew up and sank near Cuxhaven harbor, on Nov. 9th. Only eleven of the crew were saved. The LEOPOLD DAVID was converted from a destroyer in 1921, and fitted with two 300 b.h.p. Vulcan high-speed naval type Diesel engines.

The Vulcan Company has a new order for building two motor vessels of a deadweight capacity of 8,000 tons each. These vessels will have a length of about 360 feet and will be propelled by two 2,000 brake h.p. M A N-engines of the four-cycle type. The ships are destined for Italy and will be paid for by the German Government out of the reparation funds.

Karl Bostrom of Helsingfors, Finland, announces that he has arranged with the Danish-East Asiatic Company of Copenhagen, for the latter to inaugurate a direct service between Finland, Java and Australia. The motorship JAVA, 8,681 tons, left Helsingfors during November for Fremantle, Arelaide and Melbourne, and the TONGKING, 6,645 tons, is loading for Javal, Brisbane and Sydney.

John B. Bassett who was recently appointed Assistant-Engineer of the New York District of the General Electric Company, has been a member of this company for the past eleven years, with the exception of a short period during the war. When appointed to his present position, he was in charge of the Diesel-engine electric drive engineering for the New York District of the General Electric Company.

All bids received and opened at the U. S. Engineer's office, Philadelphia, for furnishing two 40 ft. motor dredge-tenders were rejected because it has been determined that larger and more powerful tenders are required to meet the needs of this office. It is expected that proposals for two motor dredge-tenders larger and of greater power will be requested in the next two or three months.

Olaf Swenson & Co.'s motor-schooner CHUKOTSK of their fur-trading fleet has re-

turned to Seattle after a gruelling battle of 600 miles with the Arctic ice-pack. This vessel makes the voyage to the Siberian coast each year, but this voyage just concluded would have been her last had it not been for the reliable operation of her 140 h.p. Fairbanks Morse oil-engine, which enabled her to batter her way through the heavy ice.

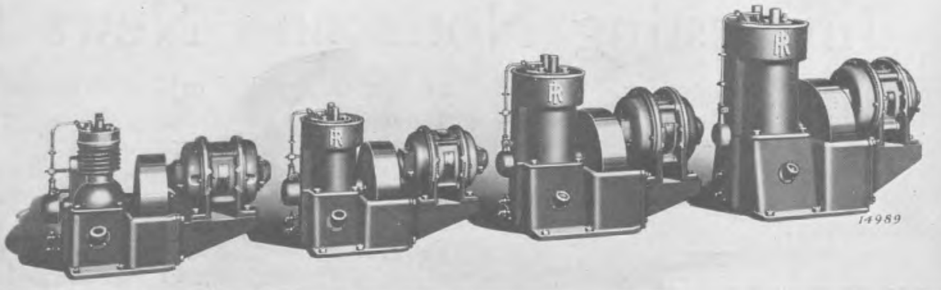
The twin-screw motorship ADRIANA, built to the order of the Societa Armatrice Ligure of Genoa, Italy, was recently launched by the Cantiere Federale of Savona, Italy. She was built to a special design by Col. Vitulli Montaruli of Genoa, by whose system of design it is claimed 20 per cent. in weight of hull is saved as compared with the usual design. Two Ansaldo-San Giorgio Diesel-engines aggregating 2,700 h.p. will drive the vessel at 10 knots on a daily fuel-consumption of about 10 tons. She will be of 4,345 gross tons.

The motorship ANVIL of the Kuskokwim Transportation Company entered the Seattle to South Eastern Alaska trade the first week in December and will carry both freight and passengers, calling at Ketchikan, Wrangell and Petersburg in the north. Operating on a regular schedule, her south-bound cargoes will consist of fish and other Alaskan products. During the summer this motorship operated between Seattle and Bethel on the Kuskokwim River, but the new winter service was arranged by Capt. Louis Knaflich, President of the Kuskokwim Company.

We suggest that American shipbuilders communicate with shipping companies in the Straits Settlements, such as the Straits Steamship Co. and the Eastern Shipping Co. of Singapore, as these concerns are figuring upon additions to their fleet of moderate sized and small coastwise vessels. Fair prices are being obtained for existing vessels at Singapore. Motorships are particularly advantageous for this service because oil is cheap while British coal is $22.50 per ton, Australian coal $22.00, while Far Eastern coal (seconds) is $16.00 to $19.00. Furthermore, small motorships can proceed to Singapore from America with a single bunker without interfering with cargo space.

The International Exhibition of Liquid Combustibles recently held in Paris offered opportunity for the Chantiers et Ateliers Augustin Normand to exhibit their 4-cycle, 4-cylinder, reversible Diesel motor of 500 h.p. at 200 r.p.m. similar to those installed in 5 patrol boats, which, during the war and since 1920 have operated with perfect satisfaction (see MOTORSHIP, Dec., 1919) The La Cie de Navigation Olivier of Paris, one of the first companies in France to employ French Diesel engines to cargo boats, are perfectly satisfied with the results of their first two vessels. This company has sold a certain number of steamers, but retains their boats powered with Normand Diesel engines because they are operated at a profit and are constantly in service.

Copper-brazed air tanks made by Wm. B. Scaife & Sons Co. of Oakmont, Pa., are installed in the Worthington Diesel-engined lighter WORTHINGTON, which was fully described and illustrated in the April issue of MOTORSHIP. While copper-brazed tanks have been used on land for almost fifty years, their use on vessels is new, and the WORTHINGTON installation was tentatively approved by the United States Bureau of Shipping. After eight months service they are absolutely tight, no leaks whatever having developed. When these tanks were tested at the factory prior to installation it was found that the brazed joint was stronger than the steel-plate itself and they were approved for a maximum working-pressure of 350 lbs. per sq. in.



AIR-COMPRESSORS FOR MOTORSHIPS

In addition to the main air-compressor on the Diesel or oil-engines of motorships and work-boats there is also required some means of quickly and economically maintaining air-pressure in the air-bottles, both for starting and injection-air. The pressure must be maintained for long periods, such as when lying at a dock for several days, with the main engines idle. For this purpose an auxiliary air-compressor driven by electric-motor is desirable, as electricity is almost entirely used as the power for driving engine-room auxiliaries on motorships. Considerable interest attaches itself, therefore, to the most recent product of the Ingersoll-Rand Company—their vertical electrically gear-driven air-compressors.

These compressors are manufactured in three sizes, 3" x 3", 3½" x 4" and 4½" x 5", all water-cooled; the smallest size is furnished as an air-cooled set as well. If belt-drive is preferred all these compressors can be furnished so equipped. In the electric-driven set both compressor and motor are mounted on a common base, alignment not being affected by installing uneven foundations, and the drive is through pinion and internal gears. In place of the enclosed crankcase and splash system of lubrication these sets are equipped with a constant-level system which insures proper supply to all bearings and lubricated parts, obviating charging the discharged air with excess oil or scoring cylinders, burning bearings, etc., because of insufficient lubrication. An oil-reservoir is formed by the base of the compressor, above which is a constant-level pan into which oil is pumped from the reservoir. Pet-cocks at high and low level are provided and a constant-level is maintained in the pan into which a projecting stem on the connecting-rod dips.

To permit starting the compressor under no load there is a centrifugal unloader which allows the electric driving motor to come up to full-speed before the load is thrown on automatically, the unloader holding the inlet-valve open until the motor has reached full speed. There is also a constant speed unloader which controls the unloading of the compressor by automatically opening the inlet-valve when the receiver pressure rises to a point higher than that at which the unloader is set to operate. When the receiver pressure has fallen a predetermined amount the unloader automatically releases the inlet-valve and allows the compressor to return to work.

WINTON-DIESEL-TUG FOR AMERICAN DREDGE COMPANY

An order for a six-cylinder 450 shaft h. p. Winton Diesel-engine has been placed by the American Dredge Co., of Philadelphia, Pa. It will be installed in a 98'x22½'x11½' tug to be built at the Sun Shipbuilding Yard at Chester, Pa. This tug will be used for towing dredges and barges.

U. S. STEEL CORP. ORDERS TWO MOTORSHIPS

Two single-screw motorships of 200 feet length have been ordered by the United States Steel Products Co. from the Federal Shipbuilding Co. Each vessel has a 250 shaft b.h.p. McIntosh & Seymour Diesel engine, purchased from the United States Shipping Board. Bids are being asked on two 60 kw. and 15 kw. Diesel electric-generating sets to install as auxiliaries in these vessels.

MOTOR COALING LIGHTER

Built to the order of the Great Grimsby Coal, Salt & Tanning Co. of Grimsby, England, by Cochrane & Sons, Ltd., of Selby, the new steel motor coaling lighter "Meadows" ran a trial-trip on October 19. She is 82' long, 20'-6" breadth, 10' moulded depth and carries 230 tons of coal. Her propelling engine is a two-cylinder 100 brake h. p. Plenty oil-engine driving a propeller working in conjunction with a Kitchen rudder.

This little lighter ran her trials under weather conditions so bad that a number of vessels were shipwrecked on the coast. During the trials the wind became so strong and the sea so rough that after 10½ hours of continuous running, during which time it was necessary to allow the vessel to drift with the tide for 2½ hours, she had finally to put into the hull for shelter because the vessel was light— having no cargo on board. On the next day the trip was continued with a tug to keep her head-on to the wind and seas. Notwithstanding this extremely severe trial-trip of a new boat the engine ran with regularity and to the complete satisfaction of the consulting-engineer of the owners, although the propeller was continually coming out of water in the rough seas. It is not often that a new installation is tested out under these conditions and such a trial is in distinct contrast to the usual procedure of selecting ideal weather and other conditions.